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DECEMBER 3, 1887.

THE AMERICAN ARCHITECT AND BUILDING NEWS

VOL. XXII. REGULAR EDITION NO. 623.

ARCHITECTURE

ENGINEERING

DECORATION

CONSTRUCTION

TICKNOR & COMPANY

BOSTON MASS.

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ILLUSTRATIONS.

Beauport, P. Q.
(Helio-Chrome issued only with Imperial Edition.)
Cottage, Friendly Island, Alexander Bay, Canada.
House, Chicago, Ill.
House, Kansas City, Mo.
Building for the Wells & Fargo Express Co., San Francisco, Cal.
Lamp-post, Philadelphia, Pa.
Wrought-iron Work.

REVIEW OF THE PRINCIPLES OF SANITARY PLUMBING AS NOW ACCEPTED BY ALL LEADING SANITARIANS.

THE main object to be attained is the complete removal of waste matters from the premises the instant they are generated. This can only be accomplished by observing the following rules:—(1.) Avoid all cesspools. (2.) Make all waste-passages as small as possible to effect their purposes. (3.) Construct every fixture on the principle of the flush-tank. (4.) Make every trap seal-retaining and self-scouring. (5.) Make all joints tight. (6.) Select the simplest appliances and the simplest system consistent with safety. These rules are self-evident enough to be accepted as plumbing axioms, and are sufficient to produce perfect work. The "Sanitas" Appliances have been constructed with a view to their fulfilment in every respect, and an examination of the steps leading to the development of these appliances will best illustrate the principles of Sanitary Plumbing, showing the faults which should be avoided, and the objects which should be sought.

Beginning with the trap: In the first place mechanical seals have been discarded as being unreliable, unnecessary, and as obstructing the water-way. We start with the simplest form of water-seal trap, the ordinary S-trap. This

trap answers all our requirements except that it has no power to retain its seal under the variations of atmospheric pressure occuring within the waste-pipes. To remedy this deficiency the pot-trap was developed from the S-trap by simply enlarging its upcast limb, a sufficient enlargement gives it a temporary power of resistance, but creates a cesspool having no self-cleansing power and, accordingly, the trap clogs, under sinks, with grease and ultimately loses its original resisting power. To avoid this difficulty we have turned the pot-trap on its side and reduced the size of its body. This permits the air to pass through the trap above the water without driving the latter out before it, as would be the case with a perpendicular body equally reduced in diameter. To still further increase the power of resistance to siphonage the body was next bent into a quadrangle, giving several reflecting surfaces, which throw back this water under siphoning action while they allow the air to escape, and, finally, the two parallel sides of the quadrangle were merged into a single body having a reflecting partition and a large clean-out cap. This gives us the perfected Sanitas-Trap, which has proved itself to be both anti-siphonic in properly arranged plumbing-work and substantially self-cleansing either with or without venting. It is more resisting than a vented S-trap.

The Sanitas is a Scientific System of Plumbing, having Simplicity and Safety for its Basis. It is also by far the most Economical System

SANITAS

APPLIANCES

they are not, they are very inferior as well as illegal.

Avoid Infringements and Imitations which are described as being "as good as the 'Sanitas;'"

PLUMBING

Considering next the Lavatory. These should always be constructed on the principle of the flush-tank, their discharges filling the water-passages "full-bore," so as to keep them clean. The overflow and outlet passages should be combined in the form of a stand-pipe, thus doing away with the usual foul, inaccessible and badly jointed lead overflow-pipe, and the troublesome and dirty plug and chain. The stand-pipe should be operated by a simple mechanism above the slab, for convenience and cleanliness, requiring but a single movement of the hand, and all parts should be of solid and durable construction, while the stand-pipe should be easily detachable for cleansing. The Sanitas Lavatories are all constructed after this principle, and they are the first ever so constructed. The stand-pipes are made of either plated metal or of earthenware, like the fixture itself, and the whole device produces a very ornamental effect, especially when decorated in colors to correspond with the decoration of the earthenware bowl. Finally, the ideal water-closet should have the simplicity of the short-hopper, with the sanitary advantages and convenience of the improved modern closets. More than this, it should be practically noiseless, anti-siphonic, quick-acting, self-sealing, and free from spattering or waste of water. These desiderata have been attained in the Sanitas Water-Closet of which we sketch the outline in section. The supply-pipe between the cistern and the closet discharges into the latter below the level of its standing water, and being without air-pipe, stands permanently full of water, hence the action is instantaneous and the noise of flushing is deadened. This and the peculiar construction of the flushing-rim and water-supply passages cause the waste to be discharged with wonderful speed and effectiveness; and at the same time so quietly that with the cover down and the toilet-room door closed, no sound of flushing can be heard from without. The closet is highly ornamental in appearance, hence no other wood-work is required than the seat and cover, and these may be supported directly on the earthenware itself, which is constructed with this in view. The Sanitas System, taken together, is the most economical as well as the only safe system of plumbing, as avoiding the dangers and complication of special trap venting. Whether vented or not it is now admitted that safety requires a trap to be *anti-siphonic*, the vent-pipe alone not being reliable. The Sanitas Trap holds sufficient water to resist, when properly set, any *back pressure* that can occur in good plumbing with properly vented soil-pipes. For more detailed description and illustration of the Sanitas Appliances, see our other Advertisements and the Circulars of

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ONE of the acts of the recent Convention of the American Institute of Architects was to appoint a committee to consult with a similar committee of the Western Association of Architects, with a view to the consolidation of all the great architectural societies of the country in one body, perhaps under the name, now dignified by many years of reputable history, of the American Institute of Architects, but with an organization adapted to the active part in professional affairs which it is desirable that the new association should take. It would hardly be courteous to the committee to anticipate its discussions of a subject which is very well presented in the paper read before the Convention by Mr. Burnham; but we may, perhaps, be of some service in the matter at this early day, by inviting, after the manner of some of the foreign societies, suggestions for a list of things desirable for the profession, which will, at least, be interesting, and, probably, valuable to those who have to consider officially the best course to take in a new effort to promote the interest of architects and architecture in America. To give an idea of the sort of suggestions we mean, we will quote from those of the Society of Architects and Engineers of the Maritime Alps, which keeps in view, among other desirable objects, the establishment of exhibitions of architectural designs, under the auspices of the Society; the regular award, at the solicitation of the Society, of prizes by the municipal authority of large cities, for the best private buildings, as is already done by Brussels and Rouen; the award of medals and other honors by the Society to members, and to draughtsmen and students in professional schools, and, on occasion, the commemoration, by statues, mural tablets, or other monuments, of great architects and artists. For this country, it would be natural to add the wish that a successful effort might be made to raise the character of the design of public buildings, and many more ideas of the sort, will, undoubtedly, occur to our readers, which we hope they will communicate to us.

A CASE was recently tried in New York, which has a decided interest for builders as well as owners. Some time ago the owner of a hotel on Sixth Avenue decided to have certain alterations made in his building, and had plans and specifications prepared, and estimates invited. The lowest offer for the work was four thousand two hundred and thirteen dollars, and the architect was instructed to draw up a contract with this bidder on the basis of his estimate. He deputed the duty of writing the contract to an assistant, who composed it in proper form. When, however, he came to filling in the amount of the consideration, he asked a fellow-draughtsman what the original bid was, and the other, by a mental slip of a very common kind, told him that it was fifty-two hundred and thirteen dollars. The contract was accordingly completed, with this as the consideration, instead of the real amount of the bid, which was a thousand dollars less. Soon after, the hotel proprietor came into the office to sign the contract; and, asking the managing assistant if it was all right, he signed it, as hundreds of easy-going persons do, without reading it. He then instructed his son, who kept his books, to pay the contractor from time to time on account, and left him a number of checks, signed in blank, for the purpose. After the work was finished, the contractor rendered a bill for the contract and extras, in which the first item was a charge of fifty-two hundred and thirteen dollars, as the contract price. The architect, after comparing the work with the specifications, and finding that everything had been done as agreed, approved the bill, without noticing the discrepancy between the contract price, as charged, and the original bid; and the hotel-proprietor's son, on presentation of the bill, certified by the architect, paid it with the blank checks left in his hands, and brought the receipt to his father. The latter, who very naturally remembered the circumstances of the bidding better than any one else, immediately perceived that a mistake had been made, and, after learning the facts, made a demand upon the contractor for the return of the thousand dollars overpaid him. The contractor refused to pay it back, on the ground that he had made a mistake of a thousand dollars in his bid, and that the contract only rectified his own mistake. The case was brought before the Court of Common Pleas, and the Court, after hearing the story, ordered that the contract should be reformed to correspond with the bid, and that the contractor should pay back the thousand dollars which he had obtained by mistake.

IT may well be doubted whether Mr. Henry G. Marquand's house in New York will not be, when finished and furnished, the most beautiful residence in the world. Of course, there are many royal palaces larger, and some bits of royal furniture more costly, than anything that Mr. Marquand has, but our experience has not served to attract us to palaces as works of art, while the furniture in most of them that we have seen would not do much credit, in point of design, to a country hotel. Mr. Marquand is one of the few people who like to have all the things about them as beautiful, in their way, as they can possibly be, and he has, what still fewer persons possess, both the appreciation of what is beautiful and the courage to get it, without troubling himself about whether it is fashionable, or what other people will say of it. A year ago, one of his rooms was decorated with the unrivalled, we might well say immortal, painting made for it by Sir Frederick Leighton, who, notwithstanding Mr. Whistler's cheap sarcasms, is as thorough an artist as any man in England. Since then, he has added to it various pieces of furniture, the most famous of which is the piano, designed by Alma-Tadema, and carried out with the coöperation of several distinguished artists. The case of this instrument, imperfect descriptions of which have appeared in many of the daily papers, is of ebony, showing the brownish streaks which brighten the natural wood. The legs are enriched with carvings in oak, set into the ebony, and the upper portion of the case is inlaid with flat ornaments in various materials and decorated with mouldings in ivory, boxwood and cedar. The principal flat ornament on the side consists of a band, which runs all around the case, and shows a Greek pattern in ebony on a background of ivory, with small rosette ornaments in the pattern, the centres of which are alternately of coral and pearl; and at each corner of the case is an interlaced inlaid ornament of ivory, cedar, boxwood and pearl. Around the top of the case is another inlaid band of ivory on a cedar ground, with spots of pearl, ebony and boxwood, and within the band are inlaid wreaths tied with ribbons, the ends of which are little balls of pearl and coral, while the names of the Muses, in pearl letters, with narrow ivory borders, occupy the interior of the wreaths. The music-rest is of wrought silver, copper and brass, and panels of repoussé silver finish the ends. The instrument is insured for forty thousand dollars, and probably cost considerably more, and is accompanied by chairs for which Mr. Marquand is said to have paid seventy-five hundred dollars apiece in London. Although these seem enormous prices for furniture, it is by no means certain that the money which they cost was not well invested, merely from a financial point of view. It is not long since about seventy thousand dollars was paid at auction for two bits of Riesener furniture, beautiful in their way, but much less interesting and artistic than the Marquand piano. Riesener's work was costly enough when

new, one of the Hamilton pieces having cost, it is said, sixteen thousand dollars to make, but the fact that it has more than doubled in value in a hundred years shows that its artistic merit has been more and more appreciated, while ordinary *boule* furniture has been consigned to the rubbish-heap, and the Marquand treasures, so long as there are people with money enough to buy them, are likely to become more and more desirable as pieces of property.

MR. IRA O. BAKER, a member of the Western Society of Civil Engineers, recently read before the Society an interesting paper on the formulas for the bearing power of piles, which is published in the *Journal* of the Association of Engineering Societies. It is hardly necessary to say that the calculation of the resistance of piles is one of the most unsatisfactory and uncertain processes which architects and engineers have to use. Of course, there are plenty of formulas, some practical and some theoretical, but these have, as a rule, been constructed to suit different special cases, and give widely divergent results when several are applied to the same example. For instance, Mr. Baker quotes an article which gives four formulas. These formulas, applied to a given case, give results so widely divergent that the largest is seventeen hundred and seventy-one times as great as the smallest. It is absurd to consider such rules as having any scientific value, and, as Mr. Baker well says, it is not creditable to the profession of engineering, or, he might have added, to that of architecture, that our knowledge of such an important subject should be in so hazy a state. We suppose that Sanders's well-known formula is that most commonly used in calculating the resistance of piles in filled land, myriads of which are driven every year in our seaport and lake cities, and experience seems to show that with hammers of about a ton weight, and a sinking at the last blow of two, three, four or five inches, its results are tolerably accurate indications of the maximum safe resistance of the pile, but under other conditions it is nearly valueless. Mr. Baker gives a striking comparison of the actual results obtained by testing a pile with those derived from the formulæ of various authors. The pile was driven with a hammer weighing nine hundred and ten pounds, falling five feet, and sank three-eighths of an inch at the last blow. By Sanders's formula, it should have been capable of supporting safely a load of eighteen thousand two hundred pounds; by Rankine's, of one hundred and twenty-eight thousand; by Haswell's, of seventy-two thousand; by Nystrom's, of nine thousand, and by Weisbach's, of one hundred and eleven thousand. On loading, it was found to bear fifty-nine thousand six hundred and eighteen pounds without moving, but sank very slowly on the addition of less than three thousand pounds. What should be the factor of safety in such cases it is impossible to say, and Sanders's, which would be about three, might not be excessive. Mr. Baker himself gives the formula, derived from analysis, $P = \sqrt{2qWh + q^2d^2} - qd$, in which W is the weight of the hammer, h the height from which it falls, in feet, d is the sinking at the last blow, also in feet, and q is a coëfficient to be determined by experiment, but which in many cases is about six thousand. Of course, this is only suggested as an attempt to "contract a little the limits of the unknown and uncertain," but it is at least interesting. One observation which Mr. Baker makes is of much importance. The record of driving piles in various places shows that a great difference in the effect of the impact of the hammer results from the "brooming" of the head of the pile. In one case, after the head of a pile which had become badly broomed was adzed off, the efficiency of the succeeding blows was nearly four times as great as before the adzing, and this should form a very important factor in determining constants for practice.

DR. SCHLEIMANN has undertaken a new work, this time on what might seem rather barren ground. He has obtained a concession from the Greek Government to excavate in the island of Cerigo, the ancient Cythera, off the Poloponnesian coast, where are still visible the remains of a temple of Venus. The antique traditions represent that Venus rose from the sea near this island, and the temple dedicated to her here was the oldest and most sacred in Greece, so that its remains would have a certain interest on this account, but they are likely to have also an ethnological and historical value from the fact that Cythera was one of the earliest colonies of the Phœnicians, and as the temple to the beautiful goddess is said to have been founded by them, the explorations can hardly fail to bring to light something bearing upon the curious problem of Phœnician influence in Greece. To the ordinary mind the results will, however, probably be far less interesting than those which may be hoped for from the excavations which are to be made by the Italian Government at Sybaris. As Cythera has been fought over, captured and sacked by nearly every Mediterranean State in succession, there can hardly be much left in the little island but property which the most inveterate plunderers did not think worth carrying away, while Sybaris, after its capture, was covered with alluvium from the river, turned from its course for the purpose, and has since slept undisturbed under this effective blanket. Moreover, while Cythera, aside from the temple, was never anything but a small town, Sybaris was a great city, at least as rich, and perhaps as populous, as Chicago or St. Louis.

L'EMULATION, the handsome publication of the Société Centrale d'Architecture de Belgique, describes a method of sinking wells, which, if not altogether new, presents advantages which are worth keeping in mind. Every one remembers the ancient device mentioned in the text-books, of making a ring of planks, building a circular wall of brick on it, and excavating under it, so as to let it descend slowly, a mason stationed on the surface continuing to build at the top of the shaft as the lower end descended into the earth. This system had the inconvenience that if the excavator in the pit happened to handle his shovel unskilfully, or to strike a vein of sand on one side of the hole, so as to let the wooden ring deviate from a horizontal position, he was liable to have the brickwork fall on his head, and it never became very popular, but the improved method, while presenting all the advantages of the old one, is free from its worst defects. Instead of a wooden ring, with a brick wall on top of it, a short ring of concrete, resembling the cement sewer-pipes once so much used, is set upright on the ground. The well-digger gets into it and digs under it, so as to let it sink vertically into the ground. Unlike the sewer-pipes, the socket, by which the joint is made with the next length, is made on the inside of the well-pipe, and forms a projecting interior ring, while the outside is smooth. The joint is formed with cement in the usual way, and the laborer, continuing to excavate at the bottom, soon makes room for the second length to descend, and so on, until the desired depth is reached. A concrete dome, with a man-hole in the middle, is then set on the top, and the well is done. No mortar is used in setting the dome, so that it may be removed, if necessary, and the well deepened by the same process as before. All the other joints are made tight with cement, and the well is perfectly secure against the entrance of surface-water, while it has the additional advantage of being cheap, easily extended to any depth, and perfectly safe for those who do the excavation, in any soil, however treacherous. In places where shafts of this sort could be made, we should generally employ driven wells, which would be cheaper still, but these do not always furnish water fast enough for use, and contain no reserve supply, so that we have known wells sunk in just the way described, except that cement drain-pipes were used, instead of the special shapes, with the sockets on the inside, which are not only smoother, but afford, by means of their interior rings, a convenient foothold for descending into the well without using ladders or ropes.

THE Swiss archæological journal *Antiqua* gives the information that several manufacturers of spurious antiquities have recently been established in the Alpine valleys. In the little town of Concise, on the Lake of Neufchâtel, is a flourishing establishment for the production of relics of the lake-dwellers, who, in pre-historic times, lived in huts built on piles over the waters of most of the Swiss lakes. Near Schaffhausen is said to be another factory, where bones are engraved with outline representations of reindeer, bears, foxes and so on, and sold as genuine relics of the cave-dwellers, who really scratched such images on bones many thousand years ago, when the reindeer inhabited the south of Europe. In still another place near the lake of Neufchâtel is a factory of relics of the stone and bronze ages, consisting of stone bracelets, bone bits for horses, bronze knives and ornaments, and other objects, which are, when finished, sent to the bric-à-brac shops at Berne and elsewhere for sale. This interesting industry is not at all approved of by the Swiss men of science, and it is to be hoped that some means will be found for putting a stop to it.

LANDSCAPE GARDENING.[1] — II.

IN a former chapter I tried to show that the intending landscape-gardener should train his eye and judgment and cultivate his taste by studying not only the works of nature but the works of artists in other branches and the broadest, deepest principles of art in general. This, however, is but the sort of study he should pursue when he is *not* studying. His real hours of work will be filled by tasks of a more prosaic kind.

It is almost superfluous to say that he must make a thoroughly scientific study of those natural elements with which he will have to deal. A knowledge of soils and exposures and climatic peculiarities, of methods of draining land, improving surfaces, building roads, managing water, transplanting trees — this is the practical foundation upon which his art must rest. Of course, too, if he would well express his ideas he must have a large vocabulary at command — if he would do the best possible thing under given circumstances, he must have the widest possible knowledge of the resources which Nature's infinite fertility supplies. It will not suffice that he shall pile his table with catalogues of trees and shrubs and flowers, or even that he shall have a broad superficial acquaintance with their aspect. He must know them all in the sense of knowing how they grow and what they need, where they will flourish and where fail, how long they will last and how they will look at various seasons of the year. He must know plants, in short, not exactly as the scientific botanist knows them, but as the practical cultivator does. If the more artistic side of his intelligence has been properly developed, there should be no danger of his falling into the cultivator's mistake of prizing individual specimens more than general effects, or thinking that when things are attractive one cannot have too many of them. Like a good painter, he will prize his general effect above everything else, yet will remember that it depends upon details, each of which is of great though subordinated importance. Indeed, he will know that his details are of much more importance than the painter's, inasmuch as his public cannot be kept at a given point of view. If he slurs details in the attempt to "generalize" in painter fashion, a few steps' advance will change his charming middle-distance into an ugly, inartistic foreground.

To learn how to drain lands and build roads implies a certain amount of education in the practice of engineering, and this should infallibly be supplemented by a certain amount of acquaintance with the principles of architecture. Almost always the landscape-gardener's and the architect's work must unite to form a single whole. Now, the landscape-gardener must ask the architect to furnish features to complete his own design — as the bridges, balustrades and shelters for a great public park. Again, he will be obliged to adapt his own work to the architect's design — as when grounds are to be laid out in the immediate neighborhood of some public or private structure. Rarely, if ever, will he be able to leave architectural elements entirely out of consideration, and, therefore, the better he understands not only the general principles and ideals of the art, but also the characteristics of its several styles, the more sure he will be of acting in harmony with the architect and of making a success of his own part of their common result.

Architectural training will also help him in another and most important direction. To learn how to plan well means that he must learn not only how to make charming pictures, but how to accommodate the people who are to enjoy them. This task is comparatively simple when small grounds are in question, but it is extremely complicated and difficult in the case, for example, of such a domain as the Central Park. To fit such a place as this for popular use, to make it at once beautiful and convenient, to preserve its landscape aspect and yet open up all its parts to vast troops of people — giving them ample accommodations for walking, driving, riding, playing, and assembling together, and insuring them safety as well as comfort — this is a task which needs for its perfect accomplishment the highest degree of creative imagination, at once practical and æsthetic in character. It is a more difficult task than the planning of the most complex structure that ever was built, yet one in which early practice in the planning of structures should be of great assistance.

In the book to which I referred in my previous chapter, Mr. Scott insists upon the necessity for preparing paper plans even when the smallest garden is to be laid out, and every other writer upon the art preaches in the same strain. The necessity for such plans is generally recognized with regard to large problems, but few clients recognize it with regard to small ones, and, I fear, not all of those who, with more or less right, call themselves professional artists. It should, however, be recognized by every student as absolutely indispensable with every class of work; and there is no exercise which will better reveal the difficulties before him and give insight into the ways in which they may be met than constant practice with imaginary problems on paper. In actual work a sight of the chosen spot will, of course, suggest to the imagination the best general scheme of treatment, and cannot possibly be dispensed with. But the scheme thus conceived cannot be tested and developed in imagination any more than an architect's first idea of a building. It is needful, however, for the student to remember that though paper is infinitely useful, it cannot be implicitly trusted with regard to grounds any more than with regard to buildings. Neither in the one case nor in the other does a pretty drawing mean the surety of a good piece of work. Practical experience must be added to closest study before true insight can be gained into the true essentials of success. Mr. Scott, by the way, instructively points out the dangers into which a planner may fall by not taking into account those laws of perspective which may cause a thing that seems good on paper to look very different in execution.

Where now, it may be asked, is this complex art of landscape-gardening taught? Unfortunately, the answer must be, Nowhere, except in the offices of the very few men who practise it on a large scale with success. The preliminary training in engineering, architecture and agriculture may, of course, be gained in various well-known schools; it is not difficult to get botanical instruction; Nature is always ready to be looked at and willing to yield up her secrets to the sympathetic eye; and an understanding of art in general and of painters' ideals and methods may be cultivated in any place where galleries and libraries are open. But there are very few botanical instructors who can explain the artistic value as well as the scientific characteristics of plants, great and small; and the landscape-gardener's art as an art — as a whole or in any of its aspects — is nowhere publicly taught. I believe there is no school for it even in Paris, where there are schools for everything else that is artistic or semi-artistic in character. In various government establishments various kinds of plants are grown in the most scientific way, and professors are employed to teach the method of their cultivation to classes of pupils on the ground. Such instruction is invaluable, of course, to those who mean to be practical cultivators, but it can help the artist only in so far as it helps him to lay the foundation upon which his art as such must rest. I imagine that the only place where the art as such can be studied is in Japan, or, perhaps, China. In Japan, I am told, there is as yet no actual school, but practised professors of the art exist, and, lest their race perish amid the new confusion into which the empire has been thrown, a government school is soon to be established. But Japan is rather too far away to attract the student of landscape-art as Paris attracts the student of architecture.

European travel, of course, will profit him much not only by enlarging his knowledge of his materials, but by showing him how his predecessors have worked. Yet, in this latter way it will hardly be so profitable as the reader may think. The great days of the art closed many years ago. There is no one now alive in England, for instance, who practises it as the great masters of the last century did. The gardener has largely taken the place of the landscape-gardener, and very many of the works the great masters left have perished. A painter's work remains intact as long as canvas and pigment hold together. But a landscape-gardener's contains within itself the seeds of rapid change, and must be perpetually and sympathetically retouched if it is to remain even the semblance of itself. Neglect has wrought havoc with countless beautiful English places; change in the conditions of local life has obliterated others; and increasing bad taste has made the retouching which has taken place a further source of injury. On the Continent the same energies of destruction have been at work. Here and there one still finds fine old parks and places in a fairly good stage of preservation, and they are numerous enough to make a European tour almost indispensable, more especially because they afford a sight of certain kinds of excellence which can hardly be said to exist in our own country. Here at home we may learn from nature how to design scenes which shall be thoroughly rural in character; but how to design scenes which must be semi-formal in order to harmonize with beautiful works of architecture, may best be learned from that which survives of the art of the past in Italy, France, Germany and England.

As to modern work abroad, some of it is good and a little is very good, but most of it is bad. The practice of the art has again changed for the better — on the Continent at least — within very recent times, and we may perhaps look to see it in process of fertile and right development in the coming years. But to-day even when work is good in general scheme — and this is by no means always — it is constantly marred by the same bad taste in matters of detail which so often shocks us at home. When we find our own clients and some of our own artists confusing the significance of the words, *landscape*, *park*, *garden*, and trying to cram into one result the beauties proper to each kind of scheme; or when we find tropical plants intruding themselves, without thought of harmony and fitness, into sylvan corners which should have a thoroughly native, natural air; or when we shudder at the chromo vulgarity of our coleus-beds, and red and pink geranium borders; or when we see pretty things huddled together into ugly masses or ugly things flaunting themselves freely, sure of admiration because they are novelties — we may, at least,

[1] Continued from page 159, No. 614.

feel sure that over the water we should find just the same mistakes, and just as many of them.

Travel on this side of the water is even more indispensable than travel abroad. Nature speaks to us more variously and naturally in America than in Europe, and our own results in the art of dealing with her materials are in general the most instructive as being the outcome of the special conditions with which the American student will have to deal. Some of our problems are analogous to those of foreign lands, but many of them are individual to ourselves. Most of our country houses are differently built, placed and surrounded from those of other countries. Our cities are differently planned. Our large parks are often laid out upon virgin soil, instead of upon sites which have already been used for other purposes. Our cemeteries are important and unique conceptions. And our villages are, in general idea and arrangement, like none in the Old World. If we add to these differences those fundamental diversities in soil, climate and atmospheric effect which must always be taken into account, it will, at least, be clear that the first travelling a student does should be in his own country. Only when he knows what is wanted here and what can well be achieved here, will he be fitted to gather useful hints abroad.

He will find many deplorable things along his course. But "shocking examples" are very useful object-lessons if analyzed for their reasons why, and with them he will also find many delightful and inspiring things — more perhaps than he will anticipate, and more, in certain directions, than he will find abroad. If we have had few professed landscape-gardeners, we have had one or two of exceptional ability; and the untutored instinct of the people has sometimes worked with singular felicity — as in the arrangement of the villages of New England.

The best preparation for a home tour would be the perusal of a book written in 1879, by M. Edouard André, and called "*L'Art des Jardins.*" The author is the foremost of living French landscape-gardeners, and has travelled widely both in this country and in Europe. His book supplies not only clear ideas with regard to the work a landscape-gardener must do, and the spirit and ways in which he must do it, and an interesting outline-history of the art, but also descriptive analyses of modern work in various lands. And it should be especially profitable to the American student as helping him to realize how well Americans have already done in his profession. In spite of that "spread-eagle" spirit which is so often attributed to us, we still hestiate to think that we have really done anything very good in any kind of art until foreign critics have told us so. Or, perhaps, I should say, we are still unable to see that we have until foreign critics point out the fact. M. André points it out with regard to our landscape-gardening work with a quality of praise which is cheering, indeed. He praises that arrangement of our villages and of some of our summer-colonies, which allows the individual beauty of each place to play its part in producing a broader general beauty — noting especially the generous and brotherly spirit which has so laid out the Newport cliffs that one house interferes as little as possible with the outlook of the others, and that the public is allowed a right of way along the brink. He speaks with enthusiasm of the schemes adopted for our cemeteries — schemes for which no precedents were found in Europe, but which, he thinks, might well be imitated there. He lauds the wise foresight which has caused the laying-out of great public parks at that early stage of civic life before land has become prohibitively dear — sometimes even before the city itself deserves the name. And he explains with particular praise the skill with which Mr. Frederick Law Olmsted — sometimes alone and sometimes assisted by Mr. Calvin Vaux — has created such parks. There is no living European artist whom he praises so greatly. There is none in whom he recognizes so high a degree of that power which is the most essential to success with large problems — the power to design broad and beautiful landscape pictures, and at the same time comfortably accommodate vast concourses of people.

In truth, there is nothing in all the world which may more profitably be studied for the fundamental quality of *good planning* than these parks of Mr. Olmsted's. When a student has arrived at the point of really appreciating all their excellence, and really understanding the ideals and the methods by which it has been arrived at, he may feel sure he has done much to fit himself for the practice of his art in whatever direction he may be called upon to work. Small problems are not very instructive with regard to the management of large ones; but the way in which a large problem has been managed — as a whole, and in its several parts — may be infinitely instructive with regard to the smallest. That is to say if the student always bear in mind that in this, as in every art the prime virtue of all virtues, is *appropriateness.*

Of all our parks the Central Park is the most interesting and instructive. Others are more beautiful — Prospect Park in Brooklyn, for instance, which is also one of Mr. Olmsted's, and perhaps, in intrinsic charm of result, the best of all. But it is more beautiful than the Central Park, because the site was more advantageous; and for this same reason it is less instructive. No task more difficult than that of making a park in the centre of Manhattan Island can ever be suggested to any landscape-gardener; and, therefore, when the student sees how successfully it has been mastered, he will learn the great lesson, *Never despair.* Moreover, while the broken, complicated nature of the ground gave less chance for those wide and majestic effects which so delight us in Prospect Park it was extremely favorable (given an extremely able designer) to the production of varied beauty in details. This park, therefore, affords a singularly good chance, not only to see how broad beauty may be created under seemingly impossible conditions, but also to study those smaller beauties which alone the landscape-gardener can attempt in very many of his problems. It is unusually rich also in architectural features, which, although sometimes not happy in detail, are almost invariably very excellent in general spirit and design.

Of course, no amount of looking at results like these, and studying backwards the processes through which they were arrived at, will train the student as would a course of subordinate effort upon similar schemes when actually under way. Such a course depends upon the chance of gaining admittance into an office like Mr. Olmsted's. If this chance offers, no desire for study of other sorts or for travel, and certainly no hasty wish to earn a living prematurely, should be allowed to interfere with it. It is the most precious opportunity which could come to a seriously-minded student.

M. G. van Rensselaer.

[To be continued.]

SAFE BUILDING.—XX.[1]

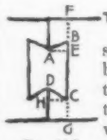


Fig. 115.

Thrust of dome. As regards abutments, there usually are none in a dome; it becomes necessary, therefore, to take up the horizontal thrust, either by metal bands around the entire dome, or by dovetailing the joints of each horizontal course. We must, of course, take the horizontal thrust existing at each joint. Thus, if we were considering the second joint H I the horizontal thrust would be $g_2\ h_2$; or, if we were considering the fifth joint J L the horizontal thrust would be $g_5\ h_5$. For the lower joint M N we might take its own horizontal thrust $g_6\ h_6$, which is smaller than $g_5\ h_5$, provided we take care of the joint J L separately; if not, we should take the larger thrust.

Metal bands. If we use a metal band its area manifestly should be strong enough to resist *one-half* the thrust, as there will be a section in tension at each end of the semi-circle, or

$$a = \frac{h}{2.\left(\frac{t}{f}\right)} \qquad (65)$$

Where a = area, in square inches, of metal bands around domes, at any joint.

Where h = the horizontal thrust at joint, in pounds.

Where $\left(\frac{t}{f}\right)$ = the safe resistance of the metal to tension, per square inch.

In our case, then, for the two lower joints, if the bands are wrought-iron, we should have, as $h = 80$ tons $= 160000$ pounds.

$$a = \frac{160000}{2.\,12000} = 6\tfrac{2}{3}$$

Or we would use a band, say, $5'' \times 1\tfrac{1}{3}''$.

Strength of dowels. If dovetailed dowels of stone are used, as shown in Fig. 115, there should be one, of course, in every vertical joint. The dowels should be large enough not to tear apart at A D, nor to shear off at A E, nor to crush A B. Similarly, care

[1] Continued from page 217, No. 619.

Glossary of Symbols. — The following letters, *in all cases*, will be found to express the same meaning, *unless distinctly otherwise stated*, viz.: —

a = *area*, in square inches.
b = *breadth*, in inches.
c = constant for *ultimate resistance to compression*, in pounds, per square inch.
d = *depth*, in inches.
e = constant for *modulus of elasticity*, in pounds-inch, that is, pounds per square inch.
f = *factor-of-safety*.
g = constant for *ultimate resistance to shearing*, per square inch, across the grain.
g_1 = constant for *ultimate resistance to shearing*, per square inch, lengthwise of the grain.
h = *height*, in inches.
i = *moment of inertia*, in inches. [See Table I.]
k = *ultimate modulus of rupture*, in pounds, per square inch.
l = *length*, in inches.
m = *moment or bending moment*, in pounds-inch.
n = *constant* in Rankine's formula for compression of long pillars. [See Table I.]
o = the *centre*.
p = the *amount* of the *left-hand re-action* (or support) of beams, in pounds.
q = the *amount* of the *right-hand re-action* (or support) of beams, in pounds.
r = *moment of resistance*, in inches. [See Table I.]
s = *strain*, in pounds.
t = constant for *ultimate resistance to tension*, in pounds, per square inch.
u = *unit-rm load*, in pounds.
v = *stress*, in pounds.
w = *load at centre*. in pounds.
x, y and z signify *unknown quantities*, either in pounds or inches.
δ = *total deflection*, in inches.
ρ^2 = *square of the radius of gyration*, in inches. [See Table I.]
$\mathfrak{D}$ = *diameter*, in inches.
$\mathfrak{r}$ = *radius*, in inches.
π = 3.14159, or, say, 3 1-7 signifies the *ratio of the circumference and diameter of a circle.*

If there are more than one of each kind, the second, third, etc., are indicated with the Roman numerals, as, for instance, a, $a_{\rm I}$, $a_{\rm II}$, $a_{\rm III}$, etc., or b, $b_{\rm I}$, $b_{\rm II}$, $b_{\rm III}$, etc.

In taking moments, or bending moments, strains, stresses, etc., to signify at what point they are taken, the letter signifying that point is added, as, for instance: —

m = moment or bending moment at *centre*.
m_A = " " " *point A*.
m_B = " " " *point B*.
m_X = " " " *point X*.
s = strain at *centre*.
s_B = " *point B*.
s_X = " *point X*.
v = stress at *centre*.
v_D = " *point D*.
v_X = " *point X*.
w = load at *centre*.
w_A = " *point A*.

should be taken that the area of C G + B F is sufficient to resist the tension, and of H C to resist the shearing.

The strain on A D will, of course, be tension and equal to one-half the horizontal thrust; the same formula holds good, therefore, as for metal bands, except, of course, that we use for $\left(\frac{t}{f}\right)$ its value for whatever stone we select. Supposing the dome to be built of average marble, we should have from Table V,

$$\left(\frac{t}{f}\right) = 70, \text{ therefore,}$$

$$a = \frac{160000}{2.\ 70} = 1143$$

Now if the dome is built in courses 2′ 6″ or 30″ high, the width of dovetail at its neck A D would need to be:

$$\text{A D} = \frac{1143}{30} = 38 \text{ inches.}$$

As this would evidently not have sufficient area at G C and B F we must make A D smaller, and shall be compelled to use either a metal dowel, or some stronger stone. By reference to Table V we find that for bluestone,

$$\left(\frac{t}{f}\right) = 140, \text{ therefore:}$$

$$a = \frac{160000}{2.\ 140} = 571 \text{ and,}$$

$$\text{A D} = \frac{571}{30} = 19 \text{ inches.}$$

This would almost do for the lower joint, which is 60″ wide, for if we made: G C + B F = 38″ and A D = 19″ it would leave $60 - 38 + 19 = 3''$ or, say, 1½″ splay; that is, D H = 1½″. Had we used iron, or even slate, however, there would be no trouble.

The shearing strain on either A E or H C will, of course, be equal to one-quarter of the horizontal thrust or

$$b = \frac{h}{4.\ d.\left(\frac{g}{f}\right)} \qquad (66)$$

Where b = the width of one-half the dowel, in inches (A E)
Where h = the horizontal thrust at the joint, in pounds
Where d = the height of the course, in inches.
Where $\left(\frac{g}{f}\right)$ = the safe resistance to shearing, per square inch, of either dowel or stone voussoir (whichever is weaker).

When the shearing stress of a stone is not known, we can take the tension instead. Thus in our case as the marble is the weaker, we should use $\left(\frac{g}{f}\right) = 70$, therefore

$$\text{A E} = \text{H C} = \frac{160000}{4.\ 30.\ 70} = 19 \text{ inches.}$$

The compression on A B need not be figured, of course, for while the strain is the same as on A E, the area of A B is somewhat larger, and all stones resist compression better than shearing.

Cambered plank arch. When a plank is "cambered," sprung up, and the ends securely confined, it becomes much stronger transversely than when lying flat. The reason is very simple, as it now acts as an arch, and forces the abutments to do part of its work. Such a plank can be calculated the same as any other arch.

Spanish tile arches. Quite a curiosity in construction, somewhat in the above line, has been recently introduced in New York by a Spanish architect. He builds floor-arches but 3″ thick, of 3 successive layers of 1″-thick tiles, up to 20′ span, and more. His arches have withstood safely test-loads of 700 pounds a square foot. The secret of the strength of his arches consists in their following closely the curve of pressure, thus avoiding tension in the voussoirs, as far as possible. But even were this to exist, it could not open a joint without bodily tearing off several tiles and opening many joints, as shown in Fig. 116, owing to the fact that each course is thoroughly bonded and breaks joints with the course below; besides this, each upper layer is attached to its lower layer by Portland-cement mortar. Specimens of these tiles have been tested for the writer and were found to be as follows:

Fig. 116.

Compression (12 days old) $c = 2911$ pounds

or say $\left(\frac{c}{f}\right) = 300$ pounds.

Tension (10 days old) $t = 287$ pounds

or say $\left(\frac{t}{f}\right) = 30$ pounds.

The shearing stress of the mortar-joints is evidently greater than the tension, as samples tested tore across the tile and could not be sheared off.

The modulus of rupture (about 10 days old) was

$k = 91$ pounds

or, say, $\left(\frac{k}{f}\right) = 10$ pounds.

Of course older specimens would prove much stronger.

There is only one valid objection that the writer has heard so far against these arches, and this is, that in case of any uneven settlement they might prove dangerous; as, of course, the margin in which the curve of pressure can safely shift in case of changed surroundings is very small. The writer does not think the objection very great, however, as settlements are apt to ruin any arch and should be carefully provided against in every case. The arches have some very great advantages. The principal one, of course, is their lightness of construction and saving of weight on the floors, walls and foundations. Then, too, in most cases iron beams can be entirely dispensed with, the arches resting directly on the brick walls; of course, there must be weight enough on the wall to resist the horizontal thrust, or else iron tie-rods must be resorted to. The former is calculated as already explained for retaining walls. If tie-rods are used, they are calculated as explained above for the example of the 7″ flat floor arch. An example of these 3″-tile arches may be of interest.

Example IX.

A segmental 3″ tile arch, built as explained above, has 20′ clear span with a rise at the centre of 20″. The floor is loaded at the rate of 150 pounds per square foot. Is the arch safe?

Example of tile arch. We divide the arch into five parts or voussoirs, each voussoir carrying 2′ of floor = 300 pounds; we make (Fig. 118) $ab = 300$ pounds, $bc = 300$ pounds, etc., and find

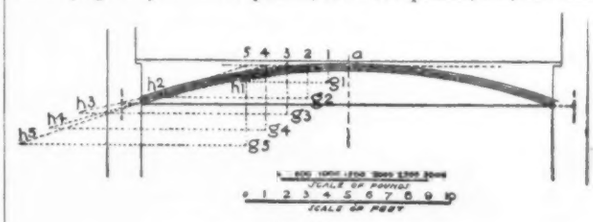


Fig. 117.

the horizontal pressures (Fig. 117) $g_1 h_1$, $g_2 h_2$, etc. The last one $g_5 h_5$ is the largest and scales 4500 units or pounds. We now make (Fig. 118) $a\ o = g_5 h_5 = 4500$ pounds and draw ob, oc, od, etc. We next construct the curve of pressure $a\ K$ and find that it coincides as closely as possible with the centre line of the arch. This means that

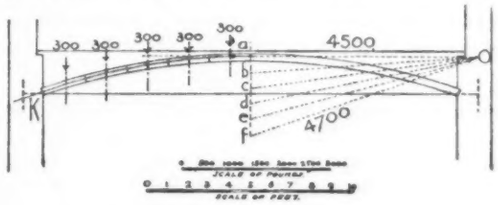


Fig. 118.

the pressure on each joint will be uniformly distributed. That on the lower joint is, of course, the largest and is = $o\ f$, which scales 4700 pounds. The area of the joint is, of course, $a = 3.\ 12 = 36$ square inches, therefore the greatest stress per square inch will be

$$\frac{4700}{36} = 130 \text{ pounds compression.}$$

As the tests gave us 300 pounds compression, per square inch, as safe stress of a sample only twelve days old, the arch is, of course, perfectly safe.

If, however, instead of a uniform load, we had to provide for a very heavy concentrated load, or heavy-moving loads, or vibrations, it would not be advisable to use these arches.

Danger of sliding. So far we have simply considered the danger of compression or tension at the joints of an arch; there is, however, another element of danger, though one that does not arise frequently, viz.: the danger of one voussoir sliding past the other. Where strong and quick-setting cements are used this danger is, of course, not very great. But in other cases, and particularly in large arches, it must be guarded against. The angle of friction of brick against brick (or stone against stone) being generally assumed at 30°, care must be taken that the angle formed by the curve of pressure at the joint, with a normal to the joint (at the point of intersection K) does not form an angle greater than 30°. If the angle be greater than 30° there is danger of sliding; if smaller, there is, of course, no danger. Thus, if in Fig. 114 we erect through K_4 a normal $K_4\ X$ to the joint, the angle $X\ K_4\ i_5$ should not exceed 30°.

Danger of shearing In arches with heavy-concentrated loads at single points, there might, in rare cases, be danger of the load shearing right through the arch. The resistance to shearing

would, of course, be directly as the vertical area of cross-section of the arch, and in such cases this area must be made large enough to resist any tendency to shear.

Depth at crown. Arches are frequently built shallower at the crown and increasing gradually in depth towards the spring, the amount being regulated, of course, by the curve of pressure and Formulæ (44) and (45).

To establish the first experimental thickness at the crown of an arch, many engineers use the empyrical formula.

$$x = y.\sqrt{r} \qquad (67)$$

Where $x =$ the depth of arch, at crown, in inches.
Where $r =$ the radius at crown, in inches.
Where $y =$ a constant, as follows:

For cut stone, in blocks:	$y = 0{,}3$
For brickwork	$y = 0{,}4$
For rubblework	$y = 0{,}45$

When Portland cement is used, a somewhat lower value may be assumed for y. The depth thus established for crown is only expermental, of course, and must be varied by calculation of curve of pressure, etc.

Approximate rule. In cases where the architect does not feel the necessity for such a close calculation of the arch, it will be sufficient to find the curve of pressure. If this curve of pressure comes *within* the inner third of arch-ring, at every point, the arch is safe, provided the thrust on each joint, divided by the area of joint, does not exceed *one-half* of the safe compressive stress of the material, or:

$$\frac{p}{a} = \frac{1}{2}\cdot\left(\frac{c}{f}\right)$$

Where $p =$ the thrust on joint, in pounds.
Where $a =$ the area of joint, in square inches.
Where $\left(\frac{c}{f}\right) =$ the safe resistance to compression, per square inch, of the material.

Louis DeCoppet Berg.

[To be continued.]

THE ILLUSTRATIONS

[Contributors are requested to send with their drawings full and adequate descriptions of the buildings, including a statement of cost.]

BEAUPORT, P. Q.

[Helio-chrome, issued only with Imperial Edition.]

COTTAGE FOR E. W. DEWEY, ESQ., FRIENDLY ISLAND, ALEXANDER BAY, CANADA. MR. W. S. KNOWLES, ARCHITECT, NEW YORK, N. Y.

HOUSE OF S. A. BROWN, ESQ., CHICAGO, ILL. MESSRS. BURLING & WHITEHOUSE, ARCHITECTS, CHICAGO, ILL.

The material of which this house is built is Bedford, Ind., stone, and hardwoods are used for the inside finish.

HOUSE OF J. J. MASTIN, ESQ., KANSAS CITY, MO. MESSRS. VAN BRUNT & HOWE, ARCHITECTS, KANSAS CITY, MO.

Owing to an error in the make-up this drawing was mentioned as amongst the illustrations of our issue for Nov. 26.

BUILDING FOR THE WELLS AND FARGO EXPRESS CO., OWNED BY F. SHARON, ESQ., SAN FRANCISCO, CAL. MESSRS. SHEPLEY, RUTAN & COOLIDGE, ARCHITECTS, BROOKLINE, MASS.

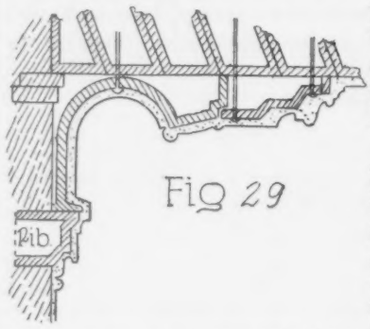
LAMP-POST FOR MARKET-ST. BRIDGE, PHILADELPHIA, PA. MR. PAUL BRANDNER, ARCHITECT, PHILADELPHIA, PA.

WROUGHT-IRON WORK DESIGNED BY MR. C. J. BROOKE.

Worn-out Boilers not Safe for Heating-Boilers. — It is a mistake often made to assume that an old worn-out boiler is "good enough for heating," says *Iron*. While it is true that a boiler which may not be strong enough to run at eighty pounds pressure will answer very well to run at a somewhat lower pressure, we do not think it quite safe to use for heating, or any other purpose, a superannuated or worn-out boiler. In many cases it is not the steam pressure itself which is alone to be considered, but the strains resulting from continuous use, to which every boiler is subject, without regard to the actual pressure carried. If the boiler has been used for a long period, and there is the slightest ground for thinking the plates unsound and brittle, it should be rejected for all kinds of work. It is a mistake to suppose that no serious explosion can occur if the pressure does not exceed twenty-five pounds per square inch. Many very destructive explosions have occurred at these pressures, and will continue to occur so long as unsound boilers are used.

UNITED STATES GOVERNMENT BUILDING PRACTICE.[1]—VII.

TERRA-COTTA WORK, ARCHING AND FIREPROOFING.



The subject of fireproofing is one which for the past twelve years has received a great deal of attention, both as regards to effectiveness and cost.

The generally accepted definition of a fireproof building is, that it is one the constructive portion of which cannot be destroyed or injured by an ordinary fire, which would burn up all the combustible material in the building; by constructive portion is meant the walls, floors, stairways and roof.

Walls built of stone or brick are generally considered to be fireproof; for the remaining construction, iron or wood must be used for the framing.

Iron though a non-combustible material is not fireproof, unless amply protected from bending or otherwise losing its strength by the action of heat. Wood is a very combustible material, but is not injured by heat if kept entirely from contact with fire. It then becomes a question to be carefully considered whether the best results are to be obtained by endeavoring to protect iron from the action of heat or wood from the contact of fire, and then to consider the cost of each. As to the best method of the two, there is, of course, difference of opinion, which need not be discussed here: as to the cost there can be no doubt that wood is much the cheaper, practically costing only about half as much as iron with fireproofing.

The fireproof buildings constructed by the Government have almost invariably been constructed of iron, which has not always been properly protected from the action of heat. The only exception is the United States building at Aberdeen, Miss., now being constructed of wooden floors and roof, with timbers, joists, etc., thoroughly encased in terra-cotta.

In the post-offices at New York and Boston, and the custom-houses at Philadelphia, Cincinnati, Chicago and St. Louis, which are usually considered first-class fireproof buildings, no provision whatever is made to protect the iron columns (of which there are a great number in each building) from heat; while all the exterior door and window frames of these buildings are made of cast-iron with fireproof shutters, at great expense, the contracts for these in each building having been from $70,000 to $100,000.

The fireproofing of buildings constructed of iron will first be considered, which consists of floor-arching between beams, encasing of columns, furring of cornices, boxing-in of girders, ceiling-plates and roof-tiles. Terra-cotta is generally used for all of the above purposes though floor-arching may be of corrugated iron, brick or terra-cotta.

SPECIFICATION.

The contractor to furnish all labor and materials, brick, terra-cotta, centring, concrete filling of haunches, of arches, skewbacks on beams and girders, etc., as shown on drawings and called for in the specification.

Proposals must be made in a lump sum for all the work required; also must be stated, in case any additional work may be required, the price per square foot for floor-arching, roof-tiles, column-casings and ceiling-plates, and the price per lineal foot for each different cornice, furring and girder-boxing, which must include all labor and materials for putting same in place.

Corrugated-Iron Arching.— This kind of arching [which is seldom used now], to be of No. 18 B. W. G. black iron lapped at joints one corrugation, and the corrugation to be not less than $\frac{3}{4}$" deep; the arch to have a height from springing to crown of not less than 4" nor more than 8"; the arches to rest on the flanges of beams or on angle-irons, bolted to flanges of beams as required.

Where corrugated-iron arching is used, it is necessary to furr down and use either terra-cotta tiles, iron or wire-cloth lathing on which to plaster, in order to protect the iron from the heat and also to provide a flat ceiling.

Centring.— For all brick and terra-cotta arches, wood centring, scaffolding and cambers to be provided, to be strongly built and firmly fixed in place before the arches are built. The slats forming centres to be close together to hold the layer of mortar for bedding the bricks in. The centres are not to be struck or eased until the mortar is set hard enough not to run through the joints.

Brick-Arching.— The entire first tier of beams, which is usually the entrance floor, to be arched in one half-brick ring. All the vault arches throughout to be in two half-brick rings. The arches to start from brick skewbacks, built in walls and from brick skewbacks which must be furnished by the contractor, moulded to fit lower flange and web of beams. The bricks to be laid dry with open joints well bonded and breaking joints bedded in the mortar on centres, and

[1] Continued from page 66, No. 606.

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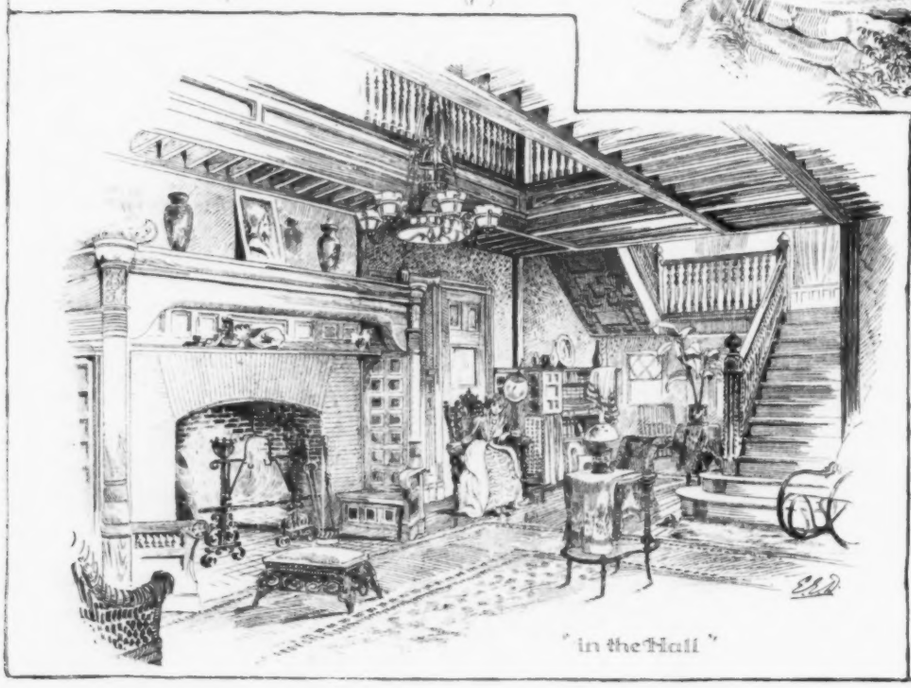
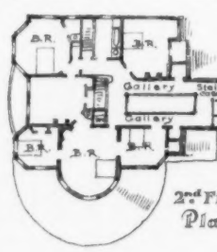
Summer Cottage on Friendly Island. Alex.r Bay. St Lawrence River. for E.W. Dewey. Esq.r New York.

Wilbur. S. Knowles. Architect 189 Broadway N.Y. City.

"General View."



"in the Hall"

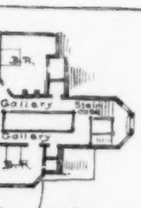


2nd F
Pla

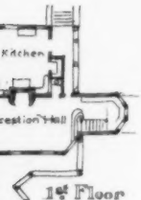
1st F
Pla

View from the River.

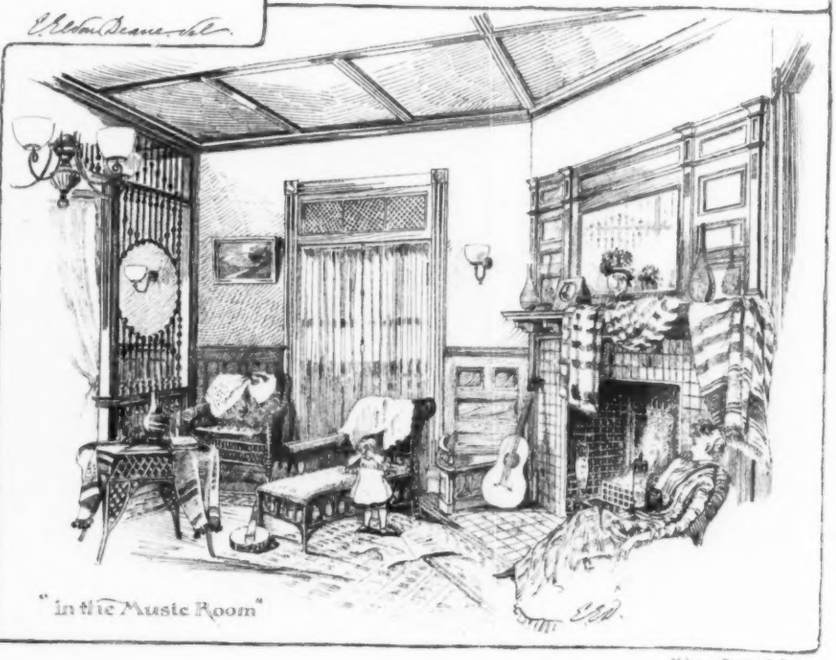
"the Ravine"



2nd Floor Plan



1st Floor Plan



"in the Music Room"

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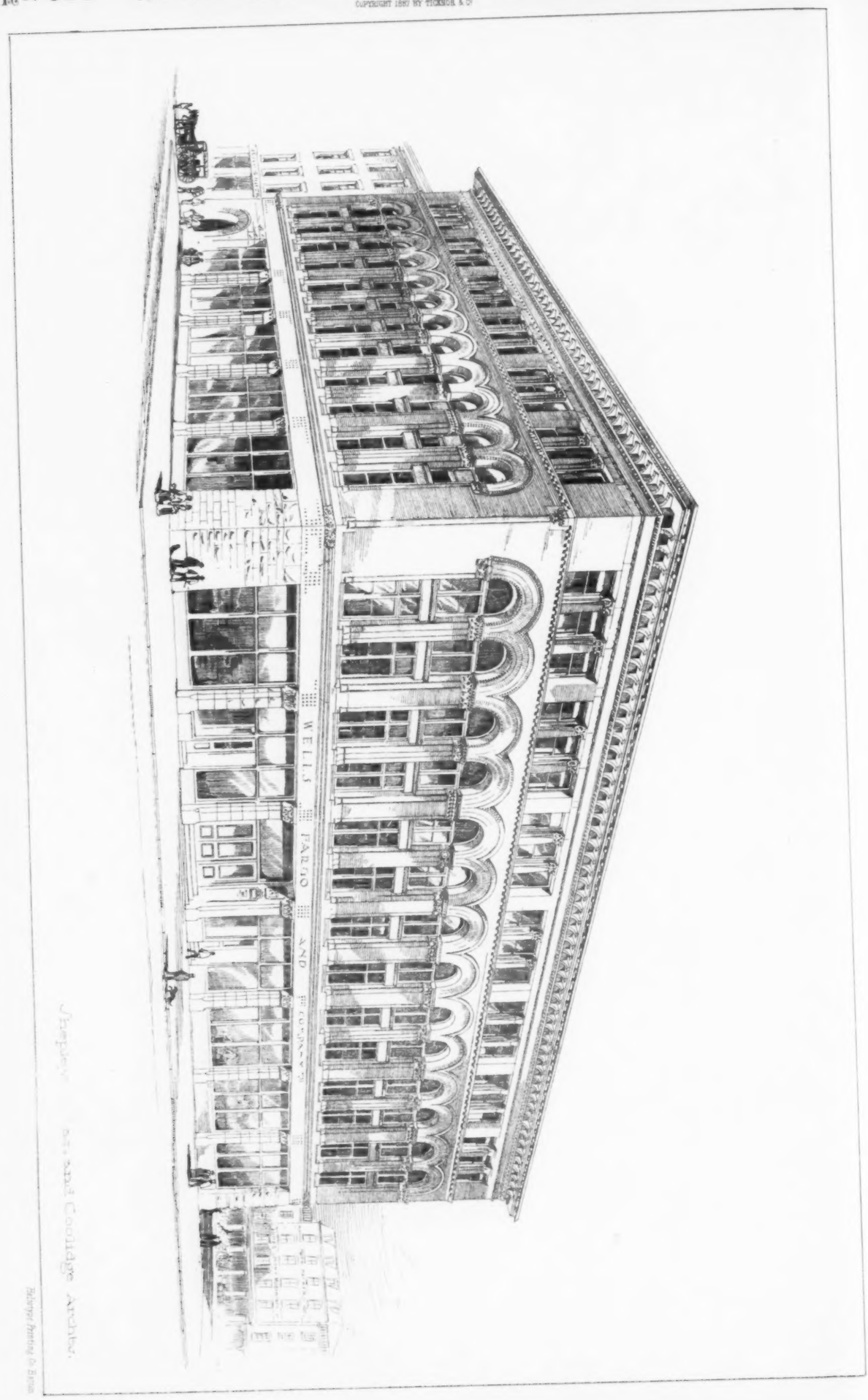

Building for the Wells and Fargo Express Co. San Francisco, Cal.

Shepley, Rutan & Coolidge, Archts.

Phototypt Printing Co. Boston

No. 623 American Architect and Building News, Dec. 3 1887

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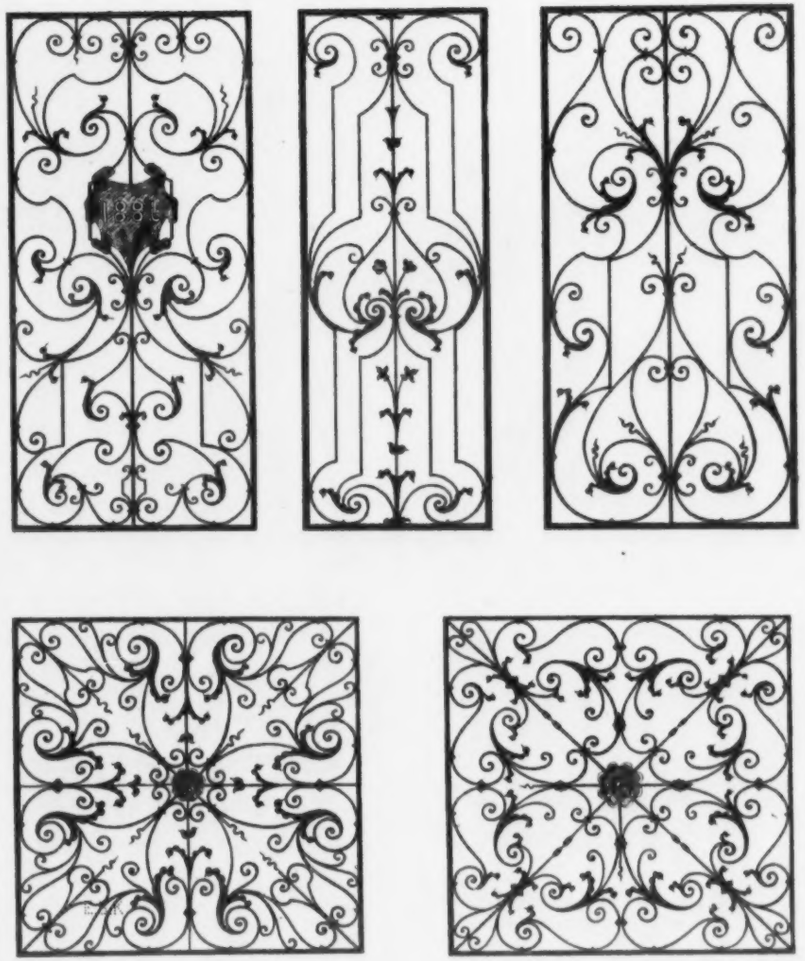
Designs for Wrought Iron Grilles

Designed by C. J. Brooke.

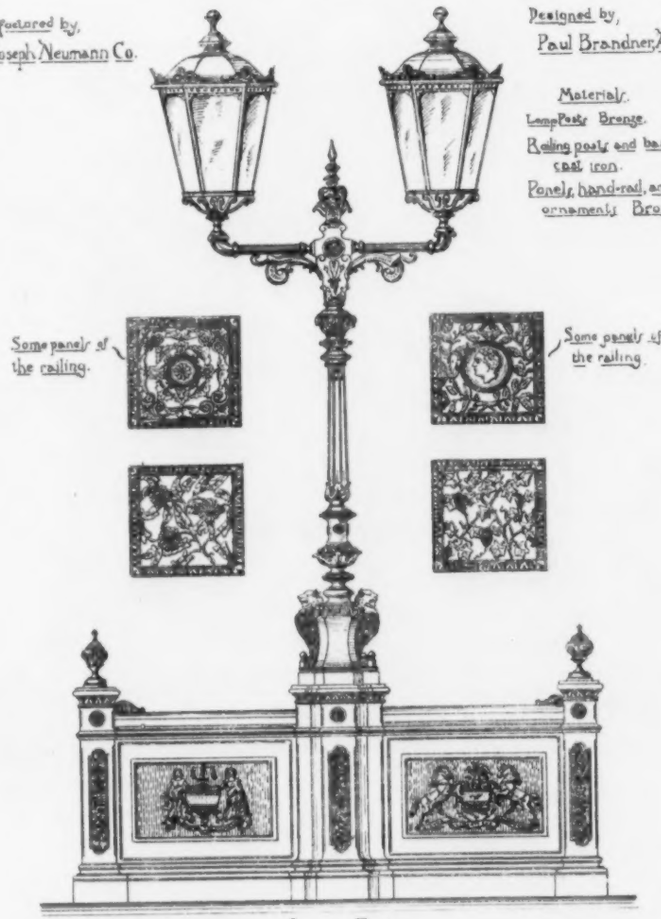


New Market Street Bridge, Philadelphia.

Manufactured by,
The Joseph Neumann Co.

Designed by,
Paul Brandner, Arch.

Materials.
Lamp Posts Bronze.
Railing posts and base cast iron.
Panels, hand-rail, and ornaments Bronze.



Lamp Post.

Scale ¾" to 1 Ft.

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RES. ON MICH. BLDV. NEAR 25 ST. CHICAGO

FOR J. A. BUCHANAN ESQ.

Heliotype Printing Co. Boston

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THE RESIDENCE OF MR. J. J. MASTIN, KANSAS CITY, MO.

Van Brunt & Howe, Architects, Boston & Kansas City.

after arch is complete the joints to be thoroughly grouted with liquid cement-mortar, well poured and worked into the joints with a trowel, until thoroughly filled so as to make brickwork solid and firm.

Where the skewbacks used do not protect soffits of beams, and it is found that such protection is necessary or that the ceiling must be plastered, nails are driven in between the flange of beam and skewback on each side about 4″ apart, and wire wrapped around nails, passing diagonally on beam soffit from nail to nail, and the beam soffit and arch plastered; the beam soffit is often ornamented by plaster mouldings and enrichments which forms additional protection.

Terra-Cotta. — All the terra-cotta for arches, furring, roof-tiles, etc., to be best quality fire-clay, mixed with 25 per cent of potter's-clay; if of brick-clay it must have a proper proportion of fire-clay mixed with it; the roof-tiles must be made porous so that a nail may be driven into, without breaking, them and hold; all to be moulded fair and true, thoroughly and evenly burned, free from cracks and defects, and each piece to be roughly scored or channeled to afford a suitable key for the plastering and when struck with a hammer to have a good, clear ring.

Arches. — The arches to be hollow with the necessary stiffening ribs, to rest against walls on brick offsets built for them, and where chases interfere a 3″ x 2″ angle-iron at same level as offset to run across chase and be secured at each end to wall by expansion bolts ⅝″ diameter 6″ long, and at beams the arches to have skewbacks fitting flanges of beams; the voussoirs and keys to vary in width sufficiently to fit the various spans of the floor beams, which are generally spaced about 4′ 6″ apart; various depths of beams are used, but all the arches are to be 9″ deep, or what is known to the trade as a 9″ flat arch. As some of the beams are less than 9″ deep, smaller sizes of skewbacks must be provided for them, and the connection to body of arch made by a special or reduced voussoir.

The soffit of each floor beam to be covered with a slab of tile, so formed as to fit closely and to be supported by the skewback on each side of beam.

Setting. — The arches to be thoroughly bedded in mortar and rubbed to a close joint; butt-joints to be neatly made and properly broken, and all cavities to be filled up.

The beam soffit tile to be bedded in mortar and shoved to place, and all joints to be well pointed. No clipped or broken tiles to be allowed in the arches, and no cutting of arches will be permitted except where absolutely necessary and under the approval of the the superintendent. All the arches must be formed to fit the various spans of the floor beams, and in all cases where necessary special patterns of voussoirs or keys must be moulded and set where it is impossible to set the regular form. No joints must exceed 3-16″ in thickness.

The arches when completed to be guaranteed to sustain with safety a load of 500 pounds per square foot of surface without deflection.

Cornice Furring. — The furring of cornices, boxing of girders, etc., to be of profiles and sections with the necessary ribs as shown by drawings, or bidders may submit prices for furring of same general outline, but of different section. The cove and ceiling piece to have holes cast for bolts, spaced not over 12″ apart (at least two bolts for each piece), the furring to have all the necessary external and internal angle pieces, or to be properly and securely mitred at angles; all to be close-jointed and properly bedded in mortar; the cove and ceiling piece to be substantially fastened in place by ¼″ diameter T-head bolts, spaced not over 12″ apart, with nuts and washers to each. Cornice furring as per Figure 29, is the style generally used.

Fireproofing of Columns. — The shafts of columns from lower to upper flanges to be covered with terra-cotta, corrugated on the inside; to be 2″ thick, and to have proper and approved method of fastening together and to shafts; to be bedded and close-jointed in mortar and left ready for plaster finish; where the shafts of columns are tapered, the covering must be properly fitted to them. The entasis of columns is formed in the plaster finish.

Ceiling-Tiles. — Ceilings where no floors come over them, usually have 3″ hollow tile supported on 3″ x 2″ ⊥ iron purlins spaced 16″ apart suspended from iron beams, or may have 2″ solid tile supported on 2″ x 2″ ⊥ iron purlins spaced and suspended in the same way; or thin tiles about ¾″ thick may be used with flanges so arranged as to hang from 1½″ x 1″ L irons spaced 16″ apart; the hangers should be long enough to keep the tile 2″ below bottom of beam. All ceiling-tiles should be properly scored or channeled to form a key for plastering.

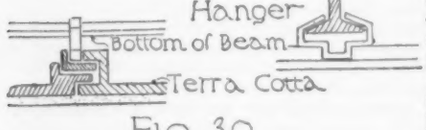


Fig 30

Roof-Tiles. — The tiles for roofs to be 2″ thick solid or 3″ thick hollow, and must be moulded to fit between and rest on the flanges of the 2″ x 2″ ⊥ bar roof purlins, which are spaced 16″ on centres, both sides of tiles to have fair surfaces and square side joints.

Fig 31

All the tiles to be bedded in cement-mortar, and the tile on the steep parts of roof to be secured by bolts (on the flat roofs the bolts are unnecessary.) The bolts to be 3-16″ diameter to run through the tiles, having 1½″ square sheet-iron washers on outside, and on inside to have plates 1½″ x 5″ crossing under the purlins from tile to tile, with the nuts of bolts on inside.

Mortar. — The mortar for setting all terra-cotta arches, furring blocks, column casings, roof and ceiling tiles, whether secured to wood or iron, to be composed of one part rich lime paste, two parts best-quality, fresh-ground, American hydraulic cement, and six parts clean, sharp sand, mixed measure for measure immediately before using.

Concrete Filling over Arches. — The concrete filling over all arches to be composed of one part cement, two parts sand, and six parts small broken stone, brick-bats, furnace-slag or cinders, to be thoroughly mixed and incorporated together, using sufficient water, and to be well rammed over arches and levelled off to bottom of flooring; and where marble tiling is to be laid, to be levelled off to ½″ below bottom of tiling.

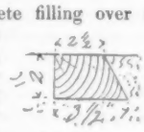


Fig 32.

For all floors where dressed flooring is to be laid, wooden sleepers of the size and section shown, to be laid and firmly bedded in the concrete, spaced 16″ on centres, with broad side down, the upper surface to be perfectly flush with concrete.

The contractor will be required to measure the quantities for all terra-cotta work and other materials at the building before shipment, as no claim for material delivered and not used will be allowed.

Fireproofing Woodwork. — Buildings constructed with wood floor-joists and roof have iron columns and girders to sustain the walls and floors, which are usually made fireproof, as already described for iron structures. For protecting wooden floor-joists, ceilings and roof, the cheapest method is by the use of wire-cloth or iron-lathing, which should cover all ceilings, stud-partitions, etc.; also the entire roof may be covered with wire-cloth lathings, plastered, on which the slate or copper may be secured by copper wire passing through holes in the slates or copper tags, and in through holes punched in the plastering and tied on the under side. This method is very simple, but great care should be taken to cover every portion of the space, ceiling, partition and roof, from brickwork to brickwork, keeping the lath at least ⅜″ away from the woodwork by the use of staples driven over iron spools or sheet-iron strips, which will also serve as stiffening-ribs for the lathing; the plastering should extend ⅜″ behind the lathing, and have the usual thickness, ¾″ on front, and should be made without plaster-of-Paris. This system has frequently been used for ceilings and partitions by the Government, but not for what are usually considered fireproof buildings.

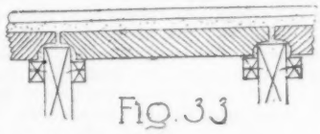


Fig. 33

Where the above method is used for ceilings, etc., the floor-joists are covered with rough, undressed boards; on these is placed an inch-thick coating of cement-mortar, in which are bedded the floor-strips, on top of which is secured the dressed flooring.

The most substantial protection for wood, as well as iron work, is terra-cotta. On top of floor-joists porous terra-cotta tiles 2″ thick are to be placed, having 1″ rebate at ends, and to rest on joists and on 1″ x 2″ strips, which are to be properly secured to floor-joists, which are spaced from 12″ to 16″ on centres, the tiles to be bedded on top of joists in mortar, with which the butting-joints are to be filled; on top of these tiles 1″ or 2″ thick concrete is usually placed, in which is imbedded the floor-strips.

All ceiling-joists, stud-partitions where necessary, and under side of rafters where exposed in rooms and halls, should be thoroughly covered with porous terra-cotta from wall to wall, so that if plastering is broken by any means, fire will find no crevices to get into the woodwork. The joists, studs, and rafters, and furring-pieces where necessary, should be spaced not over 16″ on centres. It should not be forgotten to carefully calculate the loads for floor-joists, rafters, etc., taking into account the additional weight of the terra-cotta.

Ceiling-tiles are made from ⅝″ to 2″ thick; when 2″-thick tiles are used they are generally solid, and are secured on the joists, etc., without any space intervening, by screws or wrought nails, with 1½″ or 2″ square sheet-iron washers let in flush with the surface on which the tiles are supported, as shown in Figure 34. Tiles ⅝″ thick, with the necessary ribs and flanges all around, so as to keep the surface about 2″ from the wood, are also made and secured to the wooden joists in the same manner. The latter method is the cheaper of the two and the one generally used, as the air-space between the tile and the wood is better than the solid tile.

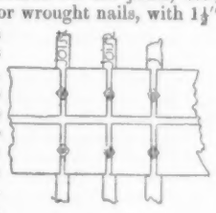


Fig 34

Figures 35 and 36 are methods often used for securing the thin ceiling-tiles in place and keeping the surface the proper distance from the joists, using band-iron fastened to wood by screws or wrought nails.

It will always be found cheaper to put in a regular tile partition from 3″ to 5″ thick, than to make a stud partition covered by tiles on both sides, and the latter should only be done when it is necessary

to frame or truss the partition to support itself without bearing its weight on the floor.

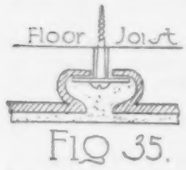


FIG 35.

Terra-cotta tiles are seldom used on top of wooden roofs under the roof covering, but tiles like those for ceilings and partitions can easily be applied to steep roofs, and like those on top of floor-joists for deck roofs.

The factories have regular stock sizes and shapes, which they make for all of the above-mentioned purposes, which, of course, are cheaper than special patterns, but any desired size and shape can easily be made to order.

MEASUREMENT.

Terra-cotta for fireproofing is usually measured by the square foot, giving the kind and thickness. The arches and ceiling-tiles, when set, to be measured from wall to wall, or from wall to web of girders or trimmers, as the case may be; the covering for shafts of columns to be measured on the outside girth at base by the extreme height; the furring for cornices to be measured by the lineal foot, giving girth, to the extreme ends of angles, mitres, etc., or, if angle-pieces are used, between the angles, and the angles counted at so much each; the roof-tile to be measured by the square foot as delivered, or, if price includes putting in place complete, by the actual roof surface on outside of tiles, allowing nothing for wastage. The above are the rules for measuring contract work.

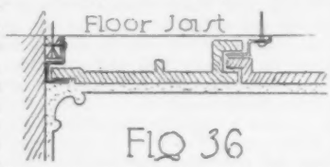


FIG 36

In estimating for roof-tiles, partitions, etc., where cutting of tiles is necessary, the measurements should be taken large to allow for wastage, but for floor-arches, which are usually made to order for special spacing of beams, this is not necessary.

COST.

The cost of fireproofing depends principally upon the kind of materials, or method employed for the purpose, and the freight on the materials to the buildings where used.

Brick arching usually requires from seven to eight bricks per square foot, and the average weight of a half-brick (or 4″) arch, including concrete-filling, is about seventy-five pounds per square foot of floor-surface; the cost averages from 25c. to 30c. per square foot, including cost of centring.

Corrugated-iron arching is measured by the square foot and costs about 20c., varying from 12c. to 25c. according to locality; it weighs, with the concrete-filling over it, about the same as brick arching. This arching requires no centring.

Terra-cotta arching is made from 4″ up to 15″ thick, and the average weight per cubic foot is forty-four pounds; the weight of the concrete-filling on top should be added to this; it costs, furnished and set in the building complete, 4″ arch about 20c., 5″ 22c., 6″ 24c., 7″ 26c., 8″ 28c., 9″ 30c., 10″ 34c., 11″ 37c., 12″ 40c., and 15″ 50c. The 9″ arch is the one generally used by the Government, average weight per square foot, with concrete, about forty-five pounds, and it is seldom that a thicker arch is needed; these have cost at Syracuse 26c. per square foot, Terre Haute, 28c., Buffalo, 30c., Jefferson City, 32c., and Dallas, Tex., 42c.

Centring for brick and terra-cotta arching costs from 8c. to 10c. per square foot, which is included in the above prices.

Concrete-filling over arching costs from 5c. to 10c. per square foot, at Syracuse, 5c., Toledo, 9c., Peoria, 8c., and Lynchburg, 7c.

Partition-blocks are generally made in sizes 18″ x 24′, from 2″ to 8″ thick, and weigh, including average hollow, about thirty-six pounds per cubic foot. They cost, furnished and set complete, 2″ about 10c., 3″ 12c., 4″ 14c., 5″ 16c., 6″ 18c., 7″ 20c., and 8″ 22c.

The cost of column-covering, 2″ thick, varies greatly; at Baltimore, Md., and Columbus, O., 16½c. per square foot, at Syracuse, N. Y., 18c., Fort Wayne, Ind., and Jefferson City, Mo., 45c., Hannibal, Mo., and Harrisonburg, Va., 52c., Pensacola, Fla., 62c., and Dallas, Tex., 68c.

Terra-cotta cornice-furring costs, furnished and set complete, about 20c. to 25c. per superficial foot, taking extreme girth, but dependent on the outline.

Ordinarily, wall-furring blocks are made 1½″, 1¾″ and 2″ thick, hollow, in sizes about 2′ x 1′, and cost, furnished and set, from 7c. to 9c. per square foot.

Ceiling-plates cost from 10c. to 12c. per square foot, furnished and secured to iron beams, and from 8c. to 10c. to wooden joists.

Terra-cotta floor-tiles on wood joists are usually made 2″ thick, about 2′ long, and from 12″ to 16″ wide, and cost furnished and set, from 10c. to 15c. per square foot.

Roof-tiles are usually made 2″ thick, 2′ long, and cost, furnished and set, including bolts and washers, about 15c. to 20c. per square foot; at Baltimore, Fort Wayne, Columbus and Syracuse, 13c., Harrisonburg, Pensacola and Toledo, 15c., Peoria, Ill., 18c., Quincy, Hannibal and Jefferson City, 20c., and Dallas, 30c.

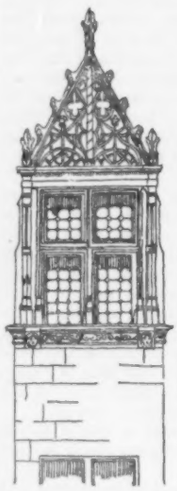
Lathing and plastering will be treated in subsequent chapters and it need only be said now, in regard to fireproofing woodwork by this process, that it costs for iron-furring and lathing, including the extra thickness of plastering, about 15c. per square foot more than ordinary wooden lathing and plastering, and wire-cloth lathing, with extra plastering, costs about 5c. per square foot more.

Jas. E. Blackwell.

[To be continued.]

HINTS FOR BUILDERS.[1]—V.

WARMING AND VENTILATION.


WINDOW FROM HOUSE AT PERIGUEUX.

I WOULD warn the student that, although the power of warming or ventilating is not at all difficult of acquirement, yet the art of warming and at the same time ventilating a room or building is a difficult one, and, though so apparently similar, are yet totally dissimilar, while, even in these advanced times, the latter, or true art, is one which is far indeed from having attained to anything like a degree of perfection. In this connection, my readers will not find a knowledge of chemistry come at all amiss to them, for this reason, that in order to arrive at satisfactory results in the arts of ventilation and warming — which should never be separated — it is advisable to be thoroughly well acquainted with the chemical conditions which surround the question. Now the combustion of fuel and the respiration of animals are very identical chemical processes in that they need for their successful accomplishment a never-ending supply of oxygen, which is usually afforded by the atmospheric air. A man of the ordinary weight and stature absorbs in the course of every twenty-four hours 9 ounces troy of carbon, the consumption of carbon during this same period being equal to 24 ounces, or 19.4 cubic feet, the quantity of air vitiated during the same time amounting to 97.2 cubic feet, and the product in carbonic acid to 33 ounces.

The products of combustion and respiration consist principally of carbonic acid mixed with the nitrogen of the air, both irrespirable gases, and which, if taken into the human body without being extensively diluted with air, would cause death. Now in the grand and wondrous economy of Nature, it has been so ordained that the poisonous products of combustion and respiration shall form, as it were, an aerial manure or fertilizer to the vegetable kingdom, supplying it with materials for growth, the organs of plants being so constructed that in appropriating and assimilating this aerial manure or waste, they in turn give fresh supplies to the atmosphere of pure oxygen; in other words, they inhale carbonic acid, or death, and exhale pure vital air or life. By the same wise ordination, the air vitiated by combustion has a strong power of ascension, due to its high temperature and consequent lightness, so that, mixing in the atmosphere, it is blown hither and thither by the winds or absorbed by the rain, whence it is distributed far and wide. So, consequently, with respect to the products of respiration. The vitiated air as it leaves the lungs has very nearly the same temperature as the blood, viz., 98°, and consequently, being specifically lighter than the surrounding air into which it is exhaled, it ascends and escapes to a higher plane. Hence, in the open air the process is perfect, there being not the slightest impediment to the immediate ascent of the bad air, but in buildings of whatever description, as usually constructed, the case is otherwise, as the vitiated air, whether it arise from combustion or respiration, rises upwards to the roof or ceiling, where, if it cannot find an egress, it accumulates, gradually becomes cooler and falls, and, mixing with the fresher air, is again inhaled into the lungs and exhaled again, doubly charged with poison, to the manifest injury of the persons breathing this poisoned atmosphere.

When the subject is examined, it appalls by its vastness, and I would, therefore, recommend every youth who may be in any way connected with the architectural professions or building trades to make himself acquainted, to a certain extent, with chemistry — to an extent, that is, to understand the laws governing the human system and its functions.

Of course, if every ceiling and roof were provided with openings by which the bad air could escape to the outer atmosphere, much illness would be obviated and life generally made more enjoyable, but, as the most elementary architect knows, there are a variety of difficulties surrounding the cutting of a hole in the roof, notwithstanding that the matter at the first blush looks an uncommonly simple one — thus, the room would not be so warm, the air would probably come in as a cold draught, while noise would be admitted from the outside, though it must always be borne in mind that in ventilating any enclosed area, the exit for the foul air must be at the highest possible point on account of the buoyancy of the vitiated air, the fresh air being, of course, admitted from the lowest possible point.

In touching briefly upon the various methods which have been

[1] Continued from page 112, No. 610.

adopted for the warming of buildings, both domestic and commercial, I do not think I can do better than begin with a glance at the open fire — at once the simplest and at the same time the most universally adopted of the many systems at different times brought forward. Strange as it may seem, it is a fact that in all countries where fuel is a scarce commodity the inhabitants suffer both mentally and morally, being alike stunted in body and mind — thus, in France, where fuel is scarce, the average height of a man is five feet four inches; in the Netherlands, where fuel is more plentiful, five feet six one-third inches; in England, where fuel is on the whole abundant, five feet nine inches, and in Sweden, six feet. It is not necessary here to touch upon the various methods pursued in different countries to obtain warmth, though I pause to remark upon the similarity of the plan adopted by some Chinese of the present day with that pursued by the ancient Romans, who employed a system of flues carried round the apartment beneath the floor, the stove being outside the building. Before the introduction of the chimney, the ancient halls of England were heated by a fire kindled in the centre, the smoke from which escaped from a hole in the roof, fitted with a turret or louvre, a plan not very dissimilar from that adopted by the Indians, Arabs and Esquimaux. It was after the Conquest that chimneys first came into use, and the fireplace was affixed to the wall. Following after the recesses in which the fire-logs were burnt came the ordinary fireplace in the improvement of which Savot was the first to move, he raising the hearth and lowering the mantel, the opening of the fireplace being about three feet high, and formed like an arch, and thus the draught was accelerated much in the same way that persons in a smoky room open the door or a window to accomplish a similar end. From this it will be seen that an upward draught is an essential in building construction if the room is not to be deluged with a black cloud of smoke, and it is in effecting this, without taking all the heat up the chimney as well, that engineers have had to overcome great difficulties, and a study of which will well repay the building student. The following remarks, which were in the main written over 150 years since, will well bear careful remembrance, and I commend them to my young readers: "It appears that those who have hitherto built or caused chimneys to be built, have only taken care to contrive in the chambers certain places where coal may be burnt, without making any due reflection that the coal in burning ought to warm those apartments and the persons who are in them; at least it is certain that but a very little heat is felt of the fire made in the ordinary chimneys, and that they might be so ordered as to send forth a great deal more, only by changing the disposition of their jambs and wings." The means by which a fire may communicate heat to a room are by radiation, reflection and conduction. Radiant heat is governed by the same law as radiant light, *i. e.*, the angle of incidence is equal to the angle of reflection, hence, it necessarily follows that in a fireplace with straight jambs, very few of the rays are reflected into the room. In 1713, onwards, Cardinal Polignac introduced several modifications into kitchen ranges, many of which were really admirable improvements upon Savot's ideas, but as these have all been long since superseded, I shall not refer to them.

The best form of register stove of moderate size for diffusing the heat into the room is that which describes a triangle. In this the sides form a right angle and the bars describe a quadrant of a circle of which the radius should be half the length of the sides, and the back one-third the width of the front. In this way the sides of the stove form an angle of 135 degrees with the back, and all the rays of heat which impinge on these sloping sides are reflected into the room in front of the stove in right lines. The falling cover or register top should form an angle of 135 degrees, with the back likewise, when it will send heat down into the room. In places where fuel is scarce the close stove is used, and in the north of Europe the stove is constructed with a view to the economy of fuel. Our space does not permit us to go over this ground of the various stoves, but we must warn students that the objects to be aimed at are the warming of the room, and *not* the chimney, consistently with proper, but not draughty ventilation; the safety of the stove, in order that the house is not set fire to, and the picturesque and harmonious appearance of the fireplace and its appointments with the furniture and style of architecture of the house. Although open stoves are generally preferred for domestic use on account of their cheerful appearance, still for the heating of large buildings there is nothing better than hot-water pipes for the sustaining of an equable temperature, but as the laying of these, like ranges, grates and stoves in reality does not legitimately come within the province of the builder but belong to the gas engineer, I shall not revert further to them here.

W. N. BROWN.

[To be continued.]

A SCANDALOUS STRIKE. — Last Saturday morning one of the bricklayers at work on the large New Arcade building, being erected by Mrs. D. G. Bush at Bellefonte, Pa., struck Mr. C. L. Calloway, who is superintending its erection. The latter at once had him arrested and subsequently discharged from his service. To-day all the other bricklayers refused to work unless their comrade be taken back The consequence was idleness to-day on the part of the workmen, but as matters have been adjusted this evening, work will be resumed to-morrow morning. — *Philadelphia Press, Nov.* 29.

NATURAL AND ARTIFICIAL HYDRAULIC CEMENTS.

WINDOW FROM HOUSE AT PERIGUEUX.

AT the last meeting of the Society of Arts held at the Institute of Technology on Thursday, November 10, Mr. U. Cummings, of Buffalo, N. Y., read a paper on "Hydraulic Cement, Natural and Artificial; their Comparative Values."

Mr. Cummings said: There are two kinds of hydraulic cement, the artificial or so-called Portland and that produced from natural cement rock. The natural cements were used in all the old engineering works in Europe, while the Portland cements were not manufactured in England till about 1824. The early history of Portland cement is filled with failures and disasters, and it was not until about 1860 that it was used to an extent worth mentioning, and it did not obtain a sound footing until about 1874. There had been but little done in the way of tensile-strain tests until 1858. It was discovered soon that the artificial cements would, if well manufactured, sustain a higher tensile strain than the natural brands, and this naturally and rapidly led to a belief in their superiority.

All hydraulic cements, whether natural or artificial, are produced by a mixture of clay and carbonate of lime, or lime and magnesia. These two ingredients are usually mixed together in a pug-mill with a free use of water. Sometimes they are ground together in a comparatively dry state. But in either method the quality of the cement depends greatly on the thorough admixture of the two materials — it being more important even than a proper combining proportion, although the latter is essential to the production of a first-class cement. After these materials are incorporated into a homogeneous mass, it is dried and made into blocks and placed in suitable kilns for calcination. The preliminary operation in calcination is the expulsion of moisture, which is soon followed by the carbonic acid contained in the carbonate of lime. Then a chemical reaction takes place. Under a high temperature, the lime rendered caustic by the expulsion of the carbonic acid and in intimate contact with the silicate of alumina, the latter is decomposed, and a new combination is formed, known as silicate of lime and alumina. If magnesia be present, then a triple silicate of lime, magnesia and alumina is formed.

In a Portland cement each atom of silicate of alumina must come in close contact with its equivalent of lime carbonate. A failure in this regard will result in the production of a cement that will heat, check and expand, thus showing the presence of free or caustic lime or free clay, and no amount of subsequent grinding or mixing will change these conditions.

[The speaker quoted from Henry Reid's work on Portland cement, to show that its manufacture will be attended with a danger that must ever be constant, so long as the matter of mixing is entrusted to human hands.]

While Nature did not always deposit her natural cement rock formations in true combining proportions, no handicraft has ever yet excelled or even approached her in the art of mechanical combinations of clay and carbonate of lime, for with natural cements, however much the proportions of ingredients may vary, as between the upper and lower layers there is usually a large percentage of the bed that is so well proportioned as to yield a good cement when all are mixed together; and even the layers that are not well proportioned, owing to their finely commingled condition, are not as dangerous an element in the mass as is that of an equal amount of an imperfect mixture in an artificial cement. As a rule, the lower layers contain more clay than those above, the proportion of clay gradually diminishing and that of carbonate of lime increasing as we ascend in the series of layers. This variation in proportion in the several layers amounts in some deposits to twenty per cent, and so it may be seen that although the cement produced from such deposits may after a thorough mixing, first in the kiln and then in the grinding, exhibit by analysis a cement made up of very fair proportions, it also shows that it is not impossible to find that a cement may be heavily overclayed and still contain free or caustic lime; and it must be seen that although the proportions may be correct, yet the percentage of true silicates cannot be predicted on such analysis, for the reason that two distinct layers of diverse proportional ingredients, when placed together in a kiln, cannot form a chemical combination, the excess of clay in one fragment cannot combine with the excess of lime in another. Fortunately, excessive varations are rarely to be met with, but it is to these facts alone that may be attributed about all the superiority that can reasonably be claimed for an artificial cement over the natural. And even in this regard the difference is not great on account of the unknown and doubtfully ascertained quantity of moisture in the chalk and clay, varying in the former from ten to twenty-five per cent and in the latter from twenty-five to sixty per cent.

It is also possible to adulterate Portland cement, and according to the printed reports of the transactions of the Association of German Portland-cement makers, adulteration with slag and other similar materials is carried on by some of the manufacturers to an alarming

extent. The maker of natural cements has no occasion to adulterate as there is no material he could use which is as cheap as the cement rock.

The natural cement-rock formations are well distributed throughout the country. They are known to exist in twenty-four of the States, and the supply is practically inexhaustible. There are now upwards of fifty manufactories in the United States, with an output the present year of nearly seven million barrels. This is the best of evidence that the quality has been universally good.

Over eighty per cent of the cement manufactured in this country contains magnesia in proportions varying from five to twenty per cent. The artificial cements contain little or no magnesia. It is claimed by the manufacturers of this grade that a first-class cement cannot be produced with magnesia as one of the bases; but there are many high authorities who dispute this proposition, and especially among the French engineers; and, as to our experience among the natural cements of this country, we find the magnesia cements among the earliest manufactured, and the consumption of upwards of fifty millions barrels of this class, used in the construction of the great engineering works of this country, is sufficient to establish the fact that the triple silicates are equally as durable as the double.

[Mr. Cummings next discussed the combining proportions of the three bases, and the different theories as to the formation of the silicates, and showed that silicates are formed during calcination and not by the action of water afterward.]

It is an error to suppose that the natural cements of this country are all about alike, and that the testing-machine will very quickly tell us whatever differences may exist. It is surprising how widely some of our natural cements may vary from the correct standard of proportions and yet sustain a high tensile strain, and be acceptable to the consumer. A well-balanced cement will withstand the action of frost many years, while an overclayed one, whether natural or artificial, will not, and of this the testing-machine gives no indication. If we take two cements, one being natural and the other artificial, and so nearly alike in composition that a chemist could not distinguish between them, the artificial will test higher than the natural product, but can it be truthfully maintained that it is the better of the two? If we are governed by prevailing public opinion we must admit it, for the testing-machine says so. Had the chemistry of cement and the laws governing combining proportions been made more of a study in the past, we should not now see the whole question submitted to this crucial test called tensile strain.

The testing-machine came into use about 1860, and the Portland cements came to be considered as better than the natural because they would stand a higher tensile strain. If the Portlands were superior, it is a little strange that such engineers as Grant, Colson, Mann and others had not discovered it in all the years prior to 1860; although it may be urged that they were confronted with the excellent work done with natural cement, in the construction of the railway tunnels, the heavy stone arches and deep foundations done during the earlier day: there was the great Thames tunnel, commenced in 1807 and completed in 1843, every stone of which was laid in natural cement and stands to-day in all its perfectness, a powerful argument in favor of natural cement. But the tensile-strain fever had set in, and men argued then, as now, that if one cement sustains a higher tensile strain than another it must be better, because it is stronger. And this argument seems unanswerable, and coupled with the fact that it is a quick and ready means by which the engineer may draw conclusions, has been the cause of its adoption to such an extent that to-day the engineer who does not have access to a testing-machine is considered behind the times.

Looking at this question from the standpoint of one who has had over thirty years of practical experience in the manufacture of cement, witnessing the entire rise and growth of this modern giant, the testing-machine, always ready to adopt any and every thing looking to an improvement in the quality of hydraulic cement, studying the action of all the leading brands in the market under varying circumstances, and devoting much time to the deeply interesting study of endeavoring to find the connecting link that ought to exist between high tensile test and first quality, and oftentimes seeing a cement that was notoriously overclayed, test one hundred pounds to the square inch, while another cement, nearly perfect in its composition, testing barely sixty pounds, and the resident engineer deciding unhesitatingly in favor of the higher testing brand, without a thought as to the question of analysis and combining proportions and all that goes to render a cement capable of withstanding the changes incident to this trying climate, with its extremes of heat and cold, we have sometimes been forcibly reminded of the old adage that "a little knowledge is a dangerous thing." During the last summer a professor of high repute in one of our leading colleges condemned outright one of the best natural cements I ever knew—a cement that had been thoroughly tried in the construction of masonry in bridge-piers, where the current was so powerful and the flow of ice in the spring so terrific that the late Colonel Eads declared that no bridge-piers could be built to withstand the shock. I mention this to illustrate the working of the testing-machine. If it can deceive a professor in one of our foremost colleges, who can it not deceive?

In our search for the connecting link that, as we have said, ought to exist between high tensile strain and first quality, we have travelled up and down the whole line, commencing with fifty per cent clay and fifty per cent lime, and following along up through its varying mixtures until pure white lime, with no clay, is reached. These we have studied under every conceivable manner of manufacture and subsequent manipulation, studying the varying proportions with all their bewildering and mystifying contradictions, plodding through the many phases that are continually being developed in the course of a long experience in the study of the natural cements of this country, searching the tables of tests made by prominent engineers from time to time, comparing the tables with analyses of the brands tested, weighing carefully every feature that gives the slightest promise of throwing light on the subject, and now, after all these years, we are compelled to admit that we have not been able to discover the slightest relationship between high test and good quality.

Practical experience teaches that we can find both good and bad cements that will test high, and good and bad cements that will test low. A cement may be so overclayed that in a barrel of 300 pounds there may be but 225 pounds of silicates or active setting matter, yet I have seen such cements test as high as 100 pounds in twenty-four hours. Such cements, when slightly underburned, behave very well in air or water, the free clay acting as a pozzuolana; excessive heat, however, greatly impairs or destroys the silicates, and, if carried to a high point, the resultant cement becomes inert. With our present modes of burning, there will be variations beyond the control of the burner, caused by changes in the direction and velocity of the wind. Yet such changes have but little effect on cements containing an excess of lime (not exceeding five per cent). Such cements will sustain a high temperature in the kiln and be benefited thereby.

If it becomes a question to decide which cement to choose, one containing an excess of clay or lime, we must unhesitatingly choose the latter. This is contrary to the prevailing belief, yet, if we accept the teachings of time, it must be conceded. The overclayed brands are at their best when fresh, while those containing an excess of lime require age to allow a thorough hydration of the free lime by exposure to bring out their best qualities. They will withstand the action of water equally as well as the overclayed brands, and for all masonry above water, or where subjected to water and air alternately, are infinitely superior. If properly hydrated, such cements will sustain immediate immersion even better than the overclayed brands, and will test equally as high, yet the fracture will show that crystalization has hardly set in at twenty-four hours, as they will yield readily to the knife, while the overclayed varieties show a much harder set, thus disproving the idea so prevalent that overlimed cements set quicker than the others.

The setting of a cement becomes slower as the proportion of lime is increased, until we pass up through the slow-setting hydraulic limes and arrive at the pure limes, where crystalization ceases. We must remember that that which causes a cement to set properly under water is also the cause of its comparatively-early disintegration when exposed to the atmosphere. A cement that carries so much lime as to require from three to six months to harden in exposed masonry will be found in perfect condition ages after the mortar made from quick-setting cements has crumbled out and disappeared.

The Aberthan hydraulic lime, consisting of 81.16 per cent of lime and 18.84 per cent of clay, the lime containing 62 per cent of silicate of lime and 38 per cent of free or caustic lime, was used in the construction of the Eddystone Light-house in 1757. It was so slow in setting that the engineer, Mr. John Smeaton, of England, covered the joints with plaster-of-Paris to protect them from the sea until the mortar hardened. This light-house stood in perfect condition over one hundred years, and until taken down to make way for a larger one. The hydraulic lime of Teil, in France, the composition of which is substantially the same as the Aberthan lime, has been in use in the form of concrete, made into blocks for sea-walls, for the past fifty-five years without showing any signs of disintegration. Neither of these limes can be made to test ten pounds in twenty-four hours if given but one hour in air, and they would stand a poor show in this country, where quality is gauged by the testing-machine. We have in the United States inexhaustible beds of hydraulic limestone, equal in every respect to those just mentioned, which probably will be utilized to only a limited extent so long as the present conditions as regards high tests exists.

Any coloring matter is an adulteration; the amount usually found, however, is of slight importance. A dark cement may or may not be a good one. A prejudice in favor of any particular color disappears when we come to learn that a really-perfect cement would be white.

Portland cement has not been in use in this country long enough to earn the position it now occupies, but, owing to some peculiarity in its molecular construction, it will test higher than our American cements, and will get harder, yet hardness is no evidence of durability. With equal exposure, a flint-stone will disintegrate much more rapidly than a soft, magnesian limestone. But the demand at present is for high test, and he would be a rash man indeed who would dare to stand against it. The manufacturers of a first-class American cement, looking back over the marvellous engineering works of the past, which have consumed upwards of seventy-five million barrels of natural cement, all manufactured in this country, and none requiring renewal on account of the poor quality of the cement used, are yet daily reminded that their cement is only a cheap article.

The testing-machine is a good thing if put to a legitimate use. It is the abuse of it that we object to. It should occupy a subordinate place. The understanding of the proper use of the machine consists

in knowing something of the chemistry of a cement, in knowing what a table of analysis means, in having a knowledge of true combining proportions, and of the effect of variations therefrom. Then the testing-machine becomes a valuable auxiliary, for its readings have taken on a new meaning.

A study of the tables of long-time tests of Portland cements, as compiled by such engineers as Clarke of Boston and MacClay of New York and others eminent in the profession, reveals the fact that briquettes of neat Portland cement do not test as high at three or four years as they do at one or two years old. I have seen works that were made with Portland-cement concrete remain in perfect condition for eight years, and during the ninth year go all to pieces. The ten-year tests of Portland cement made by Dr. Michaelis, of Berlin, show that the maximum strength was reached at the end of two years, and this point held fairly well until the end of the seventh year, but from that time until the end of the tenth year, there was a remarkable falling-off in values.

During the past summer, the engineer in charge of the Aberdeen harbor sea-works, reported a serious failure in the Portland-cement concrete works at that point. After only fifteen years' immersion it went to pieces, while the natural-cement concrete, at the same place and the same age, was in good condition. After a thorough examination by a Board of engineers, assisted by Professor Brazier of Aberdeen University, it was concluded that "Portland cement cannot resist the action of sea-water." Another case is that at the harbor of Dundee, reported upon during the past summer. In this instance the Portland-cement concrete had softened in sea-water and natural cement was used to protect it, if possible, from further disaster.

Comparing these things with the splendid record made by the natural cements used under similar circumstances, that have successfully withstood the chemical action of the sea-water for over half a century, we are led to the conclusion that man has not yet succeeded in compounding the materials essential to the production of a first-class cement that can surpass in durability that which nature has so bountifully bestowed upon us.

An interesting and lengthy discussion followed the reading of the paper, after which the meeting adjourned, with a vote of thanks to the speaker.

LOUIS FAUNCE, *Secretary.*

STEAM FOR EXTINGUISHING FIRES.

WHALPLODE CHURCH, LINCOLNSHIRE.
AFTER THE BUILDING NEWS.

THE timbering in the Calumet and Hecla Mine in the western portion of the Lake Superior district in the United States, recently caught fire, and burnt so fiercely that it defied all attempts at extinguishment, driving the miners to the surface. Progress in extinguishing the fire was made later by using a four-inch steam-pipe extending into the mine, as a means of discharging immense quantities of steam, at the same time closing up all openings to the surface. In addition to this, a large amount of carbonic-acid gas is forced into the mines; 25,000 pounds of sulphuric acid, and an equal amount of bicarbonate of soda are daily used for the purpose. At the time of writing, the fire has not yet been extinguished, although it is believed to have been very much diminished, and probably has not spread any further; but the after questions following the extinguishing of the fire will require the most enlightened engineering ability. First, the irrespirable gases must be systematically displaced by air before the mine will be habitable; and then after the people can obtain access to the mine, the measures which must be taken in regard to replacing the weakened or falling timbers by others, in order to avoid accidents from falling mine roofs, will require the utmost consideration. This mine, as is well known, is the largest in the world, having a very strong position, especially in the United States, in regard to the output of copper on the market, as well as prices, which the system of protective tariff virtually abets. Many years ago the use of steam was frequently assumed to be of great importance in the extinguishing of fires, and many American textile mills were provided with steam-pipes reaching from the boilers to the various rooms; but the results obtained from such apparatus did not justify the expectations which were anticipated from their service at time of fire, for reasons entirely outside of the value of steam in extinguishing the fire, by displacing the air which supports combustion; because many of the American mills were run by water-power, using steam for heating the mill during winter, and also, in slight quantity, for sizing, drying and dyeing during the whole year. But there would not be sufficient steam capacity, even if the pipes were of ample dimensions to deliver the required amount of steam in the short time necessary for efficient service; and when such apparatus was put to trial, under the best of circumstances it was found that the influx of steam-pressure would break out the windows, if the room was not so open as to allow its ready passage through elevator-wells, stairways, belt-holes and other parts of the building, so that as a practical result, the steam would operate rather as a steam-blast than as a fire-extinguisher. In the American oil-refineries, steam-jets are used for fire-apparatus, and generally with satisfactory results, because the plant is wisely laid out for such purposes, using boilers constantly kept for such service, with high steam-pressure and pipes of size ample to discharge an immense volume of steam into any one room, and even to keep the room full of steam, notwithstanding the various openings which may exist at the time through accident or other cause. The principle of the automatic-sprinklers which are in universal use in American mills has been used in connection with steam-jets in places where the use of water would be attended with excessive damage, as in tobacco warehouses and manufactories, where the automatic-sprinkler, instead of being secured to tees in the pipe hung pendant in the usual manner, are placed in the ends of pipes nearly one foot long, leading down from the main pipe. These short pipes are filled with water by pumping water through the whole system and then drawing it off, leaving it in the other smaller pipes; then steam is forced into the system, keeping the main pipes full of steam, but protecting the automatic-sprinklers from fusion by the steam heat by means of the interposing column of water in these short pipes. This modification of the well-known sprinkler apparatus has been put to successful use in an experimental manner, although it has not yet been subjected to the test of fire starting from accidental causes. On the other hand, steam is known to have been a cause of producing fires, not in reference to the formerly mooted question as to whether steam-pipes could produce fires by contact with the combustible substances, but the actual operation of the cause of fire by the use of the steam as a dynamic force rather than from its temperature. An instance of this kind happened in a large cordage establishment, where the hemp was sprinkled with an emulsion of whale-oil in the usual manner before treatment by the preparatory process. A large steam-pipe, some six inches in diameter, broke, the end falling into an iron tank of whale-oil, which had been presumed to be guarded against any accident which could possibly be foreseen, and the great volume of steam vaporized the oil, sending it through the building and outward into a passage-way, where it was ignited by contact with the fires under the boilers in the boiler-house, and at once spread throughout the mill. A very curious mishap occurred at this fire, because those fighting the fire noticed that there was no evidence of operation on the part of the automatic-sprinklers, and one of the workmen suddenly rushed to the valve-house in the vicinity of the building, and let the water on the sprinklers. The subject was investigated, and revealed the fact that at the time of the fire men were engaged in increasing the automatic-sprinkler plant so as to cover an extension of the mill which was just finished, and the pipes were in position, but not attached to the old pipes, and for the purpose of so doing the water had been shut off and the caps at the end of the old pipes removed for the purpose of attaching the couplings connecting the new pipes with the old system. — *Engineering.*

NOTES AND CLIPPINGS

THE SURAM TUNNEL. — A letter from a correspondent at Suram, addressed to the *Novoe Vremya*, effectually disposes of the rumor that has circulated repeatedly of late in the American press, denying that Russia had seriously taken in hand the construction of a tunnel through the ridge of the Lesser Caucasus, between Batoum and Tiflis. According to this correspondent, fair progress has already been made at one end of the tunnel, the excavation having already penetrated over 1000 ft., while at the other 200 ft. of rock have been cut away. The boring machines are of the latest description, and every improvement in tunnelling is being adopted. The total length of the tunnel will be 2 miles 300 yards, and it is expected that it will be finished by the end of next year. The cost, with that of the loop-line, will exceed 1,000,000*l.* The tunnel at one part passes through clay and will require to be lined with stone, but a good deal consists of solid rock, which requires to be blasted by dynamite. Pending the construction of the new line, the traffic over the Suram Pass still continues in a very congested condition, the two 72-ton Fairlie engines being able, owing to the heavy gradient, to haul only eight or nine trucks over the pass at a time. To relieve the congestion the Government has sanctioned the laying of kerosene pipe-lines, 37 miles long, over the pass. Messrs. Nobel and Rothschild have already received permission to lay down pipe-lines of their own, and other competitors are in the field. When the final concessions are signed by the Government very little time will be needed to manufacture and lay down these lines; Messrs. A. and J. Stewart, of Glasgow, for instance, who supplied 55 miles of pipe-line for the Suakin-Berber Railway at the rate of a mile a day, being able to execute such a pipe-line in about three weeks, and a few weeks more would be sufficient to lay it down and get it in working order. — *Engineering.*

PORPHYRY QUARRIES IN EGYPT. — Egyptian porphyry has been sought after from the earliest times as one of the most precious building stones. Ancient writers differ as to the whereabouts of the quarries from which that stone was obtained, and in modern times they were literally rediscovered by Burton and Wilkinson in 1823, and subsequently visited by Lepsius in 1845. The information published by these visitors proving of no immediately practical value, Mr. W. Brindley determined to follow in the footsteps of Wilkinson, and in a paper, of which an abstract is published in *Nature*, gives an account of his visit. Having examined the ancient granite quarries at the first cataract, which supplied deep red, rose and dark gray stone, which was quarried by metal wedges, and not wood (as is generally supposed), the author

started from Keneh with a small caravan and supplies calculated to last three weeks. Passing the remains of several Roman stations the author, on the fifth day, reached an excellent well in the charming Wadi Kitar, hemmed-in on three sides by precipitous mountains. Soon after leaving this valley he crossed the water-shed (2400 feet above the Nile), and then travelled along the flank of the immense porphyry mountain of Gebel Dukhan as far as the old Roman station with an old fort. The morning after his arrival the author ascended to the top of a pass (3100 feet) without having found even a fragment of porphyry; but espying by the aid of a good field-glass porphyry coloring on the opposite mountain he resolved to go there, and his delight knew no bounds when he found the ground there strewn with pieces of the most sumptuous porphyry, and discovered a pitched way or slide, 16 feet wide, down which the blocks were lowered. Further examination led him to the locality where the Romans had extracted their grandest masses, and he found that these quarries had yielded not only the usual spotted variety, but also the brecciated sorts and green-grays. The great quarry was at an altitude of 3650 feet above the sea, and a road led down from it to an ancient town with workshops. A path led hence to the old town in the valley, farther up which are the ruins of a Roman temple. The blocks were formerly carried to the Nile, a distance of 96 miles, but they will in future be conveyed by a gentle incline to the Red Sea, which is about 25 miles distant. On his return to Cairo the author secured a concession to rework the quarries, the terms of which have been ratified.

Steel used for Roofing. — Roofs of great span are not uncommon in England. Till the construction of the iron roof over the Olympia at Addison road, St. Pancras-station roof, which has a span of 239 feet, held the reputation of being the greatest. But these roofs are to be exceeded by one designed in connection with the Machinery Palace being erected for the French Exhibition of 1889. The project of a machinery gallery was decided upon in May last, and the work was submitted to contract. M. Dutort is the architect of the machinery palace, and, with the aid of MM. Contamin, Charlton, and Pierron, the details of the metallic pieces have been arranged. The gallery is constructed entirely of steel — the first great exemplification of the value of steel for structural purposes of this kind — and when finished the structure will embody the progressive developments made in the art of the engineer. The gallery will be of rectangular shape in plan, having a length of 1,387 feet and a width of 492 feet, or an area of 672,404 square feet. The main span will be 362 feet clear of tie-rods. Each truss forms a four-centered arch of bold springing curvature, and will consist of two half-arches resting at their bases and apices upon pivots. Each rib is on the open lattice principle, with long and short panels. These are connected by vertical purlins, four on each side of the apex. The maximum height from the ground to the upper pivot is 147.5 feet, which height would allow the Vendome column to stand beneath. Open spandrel pieces of iron fill up the ribs at the haunches, by which the roof covering is continued straight to the outer guttering. There are nineteen bays. The central bay is seventy-six feet, and the other seventy feet each in width, and the end ones each eighty-three feet. Projecting pavilions roofed on a lower level abut against the central hall, thus adding greatly to the total superficial area. By the employment of steel, M. Contamin and his colleagues have been able to obtain strength with extreme lightness, so that the trusses will not exceed twenty-four pounds per square foot. If this be so, the gallery will possess the lightest metallic roof of any exhibition. The former exhibition had metallic frameworks, weighing from thirty pounds to thirty-four pounds to the square foot. Though it is not safe to compare structures of different design, it would appear the experiment at the machinery palace of the Paris Exhibition of 1889 will confirm the opinion of engineers that steel can be used for roofing with economic results that cannot be obtained in iron. — *Industrial World.*

Old Italian Castles. — The ruined castles and the numerous relics of the past which are found on the mountain summits of the Apennines bear testimony in their decay, not so much to the strength and skill of the repeated attacks to which they were exposed (for in many cases they were impregnable before the invention of artillery), but, unfortunately, to the neglect of their owners, arising mainly from the reverses which the great families from time to time experienced. Most of the illustrious Italian houses were connected with trade; this was a characteristic of the great republic; at least one member of each family was enrolled in some guild or mercantile corporation. This connection with trade in no degree diminished the refinement of taste or the love of the beautiful of the most illustrious of the Florentines. On the contrary, the merchant princes, with the richest products of other climes, gained much experience and art knowledge, which found their expression in the noble works and the adornment of their cities. But there was one evil result of this association of nobility of race and commercial pursuits, that it rendered their prosperity very precarious; the frequent revolutions in the Italian republics arose as much from commercial as from military causes. The middle of the fourteenth century was especially a period of great speculation and of much suffering to many of the most illustrious houses — the Bardi, the Anciaioli, the Mozzi, the Peruzzi, were all struck down. — *Blackwood's Magazine.*

Swiss Families. — Since the application of the Code Napoléon to Switzerland, families may be regarded roughly as joint-stock companies, managed by the parents for the common benefit. It is known that when both parents die, the estate will be divided into equal portions among the children, boys and girls sharing alike. All money, therefore, which is drawn from the estate by sons and daughters for extraordinary purposes is debited against them. If a boy, for instance, elects to be a doctor, he anticipates his share in the eventual division. All labor expended by them on the estate is reckoned to their credit. If a boy stays at home and works like a farm servant, he acquires a future claim in proportion to his service rendered. It is for the interest of each member to pay off debts upon the property or to increase its value. Consequently, when a son goes out into the world, after his education has been completed, it is expected of him to remit a portion of his earnings to the family fund. This stands in lieu of work he might have done at home and also as a recognition of his early rearing. The precise amount to be thus contributed by individuals is determined by feeling and instinct more than by any fixed rule. The system cannot have the exactitude of a mercantile concern, yet it approximates to that standard. The result is that both sons and daughters in a Swiss family feel it their duty either to discharge personal functions in the home or else to send a part of their gains yearly back to the common stock. — *Cornhill Magazine.*

TRADE SURVEYS

The fact that $145,000,000 of foreign capital has been invested in American railway securities in one way or another within the past six months is one of those hidden sources of strength that is helping to cause a reaction in railway circles with reference to next year's railway building. The demand for railway securities in London and other foreign centres has caused an advance, and the reaction on this side is having an excellent effect. Foreign buyers and lenders of money are showing more confidence in American railway management, a result which is largely due to the workings of the inter-State commerce law, and the creditable desire manifested by railway managers to honestly carry out its purposes. Railway managers are getting together East, West and South, to harmonize matters, and are meeting with encouraging success. The effect of this improvement will be to encourage railway building enterprises, which received a little set-back two months ago. Arrangements are being made by the Northern Pacific, the Central Pacific and the Canadian Pacific Companies to harmonize their business interests between Chicago and the Pacific Coast, with a view to lessen competition and to secure uniformity in traffic rates. The far Northwest is rapidly building up, and the fears which were entertained a few months ago relative to the revival of a disastrous railway war seem to be dissipated already. The Northern Pacific Railroad Company has just given an order for 2,000 freight cars, and needs 5,000. The trunk-line railroads between the Atlantic Coast and Chicago need 10,000 more cars than they have for present requirements, and will place the orders as fast as the car-building capacity can take care of them. Facts like these deserve more than a passing notice, because of the meaning they have with reference to next year's operations. On the other hand, railroad building interests which would place orders for as much as half a million tons of rails, if prices were suitable, are still hanging back, declining to pay the prices asked, believing that their policy will force makers to accept $30 or $31. Three rail mills have temporarily shut down, and other mills will do the same rather than accept anything under $32. Several new railroad building enterprises will be brought to the attention of financiers in New York and Boston during December and January, with a view to the development of a large section of country between Missouri and Mexico. The anthracite coal trade is extraordinarily active. The production at this time is about 125,000 tons per day. The production will be about 34,000,000 tons for the year. At present the excess over this time last year is 2,250,000 tons in round figures. The Pennsylvania Railroad Company is carrying 52,000 tons of coal and coke per day over its lines. The Reading Company is averaging 165,000 tons of anthracite. The Cumberland lines are averaging 80,000 tons per week. The production of bituminous and anthracite coal is far ahead of anything ever known. The shutting-down of navigation will throw large quantities, now going West, into Eastern markets, and ease up the excited condition which the anthracite strike has maintained for six weeks past. The strike will probably be a failure, although the miners are more determined at this time on account of the assistance so freely tendered them. The lumber trade is no exception to the general activity. The great demand for all kinds of lumber is stimulating speculation. One operator has just purchased sixty million feet of pine land in the Duluth district. Large parties have closed contracts for about one hundred million feet of logs during the past week in the Northwest. Larger and heavier contracts than usual are being closed in the South for Western and Northern shipment. Southern lumber manufacturers have been crowding capacity very rapidly, and thirty million feet of stock are now awaiting shipment at Pensacola. The cut of lumber this season in the upper Mississippi district, of which Minneapolis is the centre, is 262,000,000; of shingles, 81,000,000; and of lath, 55,000,000. Over 100 million feet of logs are in readiness for next spring's sawing. There is a boom in saw-mill building and improvements in that region. The lumber manufacturing activity in the South is largely due to the building-up of industries. In Birmingham alone 2,000 houses have been built. Saw-mills are springing up, and saw-mill machinery is being ordered faster than ever before known. The present upward tendency in prices is phenomenal. It has come at a time when least expected. Capacity of every kind has been expanding steadily for two years, and instead of lower prices we find wheat, corn, cotton, sugar, petroleum, copper, lead, tin, and even some kinds of iron and steel, higher than for months past. Naturally, a reaction is looked for. The basis of this improvement may be legitimate enough, and to all appearances it is, but an upward tendency generally reacts, because of the stimulus it gives to productive capacity. One class of thinkers attribute this rapid growth to the opportunities afforded enterprise by an increase in the volume of money. No doubt this fact has much to do with the present healthful condition of trade. More money generally means higher values, and higher values often disarrange the great factors of trade, and necessitate a reorganization, frequently through bankruptcy more or less general. It is useless, however, to borrow trouble on this score. The country is making rapid strides. We cannot measure our conduct altogether by old rules or old standards. Everything is unusual and phenomenal. The wisest predictions of financiers and builders have repeatedly proved false. The real capacity of the country is not understood. There are greater opportunities than the most sanguine anticipate. The panics which have overtaken us every few years in the past, are looked for in the future, but the causes which have brought them about may not recur, and wisdom which is born of experience, is enabling us to so regulate our affairs to make their recurrence less probable. Nothing would sooner bring about a reaction than a scarcity of money, just as a scarcity of rolling-stock would very soon interfere with the easy transaction of the business of a railroad. The West and South is rapidly filling up. Land is still advancing in value in certain localities. The real-estate value of the entire West has improved, and even should a depression overtake the country, much of it will retain its present value, because it is held by strong parties who can afford to wait for another rising tide.

S. J. Parkhill & Co., Printers, Boston.

The American Architect and Building News

ADVERTISERS' TRADE SUPPLEMENT.

No. 66. SATURDAY, DECEMBER 3, 1887. Volume XXII. No. 623.

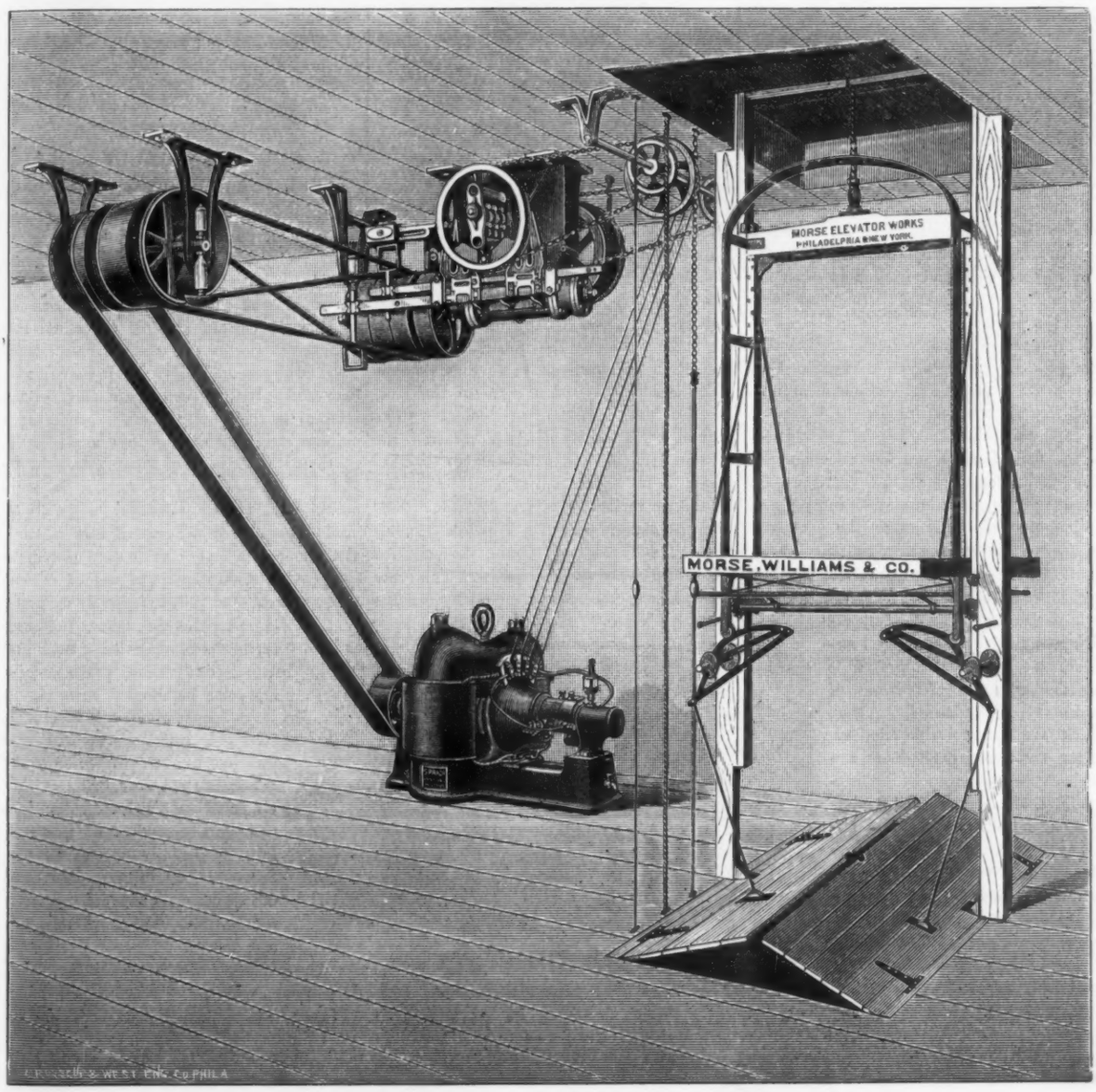
BELT-POWER SCREW HOIST.

This machine has several new improvements to which we would call attention.

1. To our belt-shifter, which is a principal feature in a power-hoist. It is simple and not liable to get out of order, as it has no rack, gearing or link motion, and is so arranged that while either of the belts are being shifted to the fast pulley the other remains undisturbed. We also have an attachment which prevents the belt from shifting too far or reversing the machine, as it will stop central and leave the belts free from the fast pulley. As all parts are made interchangeable, the machine can readily be changed from left to right hand, or *vice versa*. It also has a slack cable-shifter, a very valuable device, which shifts the belt and applies the brake so machinery is stopped as soon as suspension cable slacks up from car being in any way obstructed in its descent.

2. The automatic-stop, which can be set to stop the machine at any point, either hoisting or lowering, is so positive that we can rely upon it without depending upon the stops generally used on the shifting-rod or cable.

3. The brake is new in arrangement, is very powerful, and does not touch the pulley until



it is brought into use; and by means of a compound lever and weight, the wear is taken up automatically, thus obviating the necessity of frequent adjustment, as in other elevators.

4. The drum, on which the cable winds, is grooved, which prevents the cable from touching while winding, thus making it wear much longer.

5. The driving-worm, which runs at a high speed, is cut perfectly true, and enclosed with gear-wheel, which is also cut, in an oil-tight case or housing, and run in oil.

6. The pulleys are made with large hubs, have a chamber for Albany grease or a similar lubricator, and are bushed with deoxidized bronze.

The machine is fitted up in a mechanical and substantial manner.

The Albro-Hindley worm is cut from a blank, which is curved to correspond with the arc of the wheel. By making the worm or screw of this peculiar shape, it will readily be seen that there is a variation of pitch from point to root of tooth; this variation of distance from centre to centre of teeth in worm exactly corresponds to the two diameters of teeth in wheel, thus giving a perfect bearing-surface the whole length of worm, and causing the two surfaces to travel at proper speed and with great steadiness of motion. The diameter of the worm is constantly changing as it revolves, and one tooth or thread does not follow exactly in the track of the one preceding, which makes it impossible (if properly lubricated) to cut or unduly wear the teeth, either of worm or wheel. The strain being distributed over so much bearing-surface, the motion is steadier, the speed can be increased fifty per cent without risk, and friction is much less than in old-style machines, thereby consuming much less power.

The pneumatic safety-clutch consists of a thin vane of poplar wood, strengthened by iron strips, connected by links and arms to steel shafts extending across the bottom of car, and projecting each side of guide posts, on the end of which are toothed eccentrics. Any undue acceleration of speed of car causes the air to lift the vane, the slightest motion of which will cause the eccentrics to grip the guides instantly, and the heavier the load the tighter the grip. The platform or car is made of good ash lumber, any size or style desired, and has a safety attachment (which we test on all machines so constructed) to prevent it from falling in case of breakage of cable or rope; also has roller guides, which save a great deal of friction.

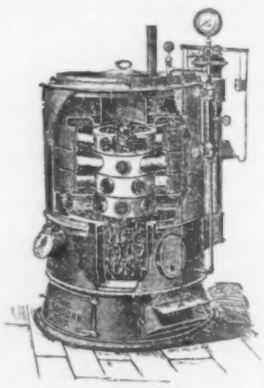
Our automatic hatch-doors are the most perfect covers in the market, and are endorsed by underwriters generally on account of lessening the risk of spreading of fire. The crank levers, which open the door as car descends, are adjustable, so that in case of a settling of the floors, shrinkage of woodwork, or wear in the joints, the levers can be quickly adjusted to open the door to its proper place, recessed in post. The patent joint between door and post closes the opening perfectly. The laws of some States require the use of automatic hatch-doors, and self-interest in the preservation of life and property should induce every one using elevators to have them applied.

MORSE, WILLIAMS & CO.
411-413 Cherry Street, Philadelphia.

THE "AUBURN" BOILER

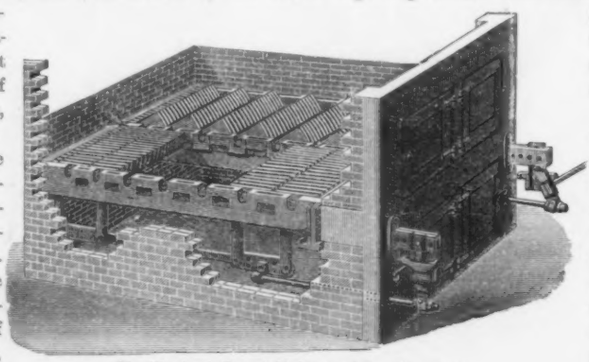
FOR STEAM AND WATER HEATING, AND THE WOODCOCK PATENT SHAKING AND DUMPING GRATE.

This boiler is adapted to heating dwellings, stores, churches, schools, greenhouses, public buildings, etc., by either steam or water, and is so constructed as to give the greatest amount of fire-surface. It requires but little attention in operation, and has no parts which are liable to give out. It is very economical in the use of fuel, and by means of the Woodcock patent grate it is an utter impossibility to waste any coal, as none can fall through. No black ash-heaps will be seen where this grate is used. The boiler illustrated by the



Woodcock & Co.'s Boiler.

first engraving is manufactured by Messrs. Woodcock & Co., Auburn, N. Y. The New York agents are Edward E. Gold & Co. This boiler has points of merit in its construction peculiar to itself alone, the novel manner in which the fuel-magazine is formed and entirely surrounded by water being one, the water protecting the iron from becoming burned at the lower end, at the same time the water is confined within some of the most effective fire surfaces imaginable. "The "Auburn" is made entirely of cast-iron, the sections being so constructed and put together as not to be injuriously affected by sudden or severe variations of temperature. This firm also manufacture the Woodcock Patent Shaking and Dumping Grate, designed for boiler furnaces of all descriptions. This grate illustrated by the second engraving consists



The Woodcock Patent Shaking and Dumping Grate.

of a number of segmental sections, each of which has a number of fingers projecting horizontally from a bar, which has bearings at both ends, the bar itself being below the surface to admit of greater air-space. By means of downwardly projecting lugs connected together, the grates may be simultaneously tipped at the same angle, and by means of the stop arrangement cannot pass each other, thereby preventing waste of coal. By throwing the lock out of connection the grates may be dumped when desired. On the withdrawal of the shaking-lever the grates are left perfectly level by means of a self-locking device, thereby preventing their points being left up in the fire and becoming burned. The shaking-apparatus may be applied either on the inside or outside of the boiler front, the latter way obviating opening the doors to shake the grate, and, consequently preventing any dust arising. The adjacent bars keep a uniform distance apart in shaking. No matter how inexperienced the fireman may be, or how hard they may be shaken, they can only go so far, except by throwing the stop-motion out of gear, and, consequently, it is impossible to waste fuel. These grates are provided with the greatest possible amount of air-space equally distributed, so that the fire will burn as well at the sides or ends as in the middle, consequently a great draught and perfect combustion is secured. With a comparatively small consumption of coal the largest percentage of steam is furnished. The grates are adapted to burn any size of coal, and although the patents are only a few months old a great many of them have been placed in different sections of the country. An illustrated catalogue of fifty-six pages, giving a full description of the boiler and grate, will be sent to any address on application.

WOODCOCK & CO.
Auburn, N. Y.

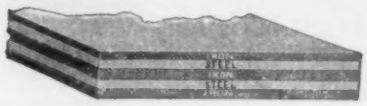
THE GREAT VALUE OF CHROME STEEL FOR BUILDING PURPOSES.

The value of chrome steel for building purposes in all positions where absolute safety and security is desirable cannot be over-estimated. It is not, as often supposed, a brand of carbon steel with the word *chrome* as the trade-mark, but an alloy of chromium and iron, the proportions of which are accurately weighed and scrupulously exact in every grade, both metals, uniting perfectly in alloy, become integral in their unity, thereby producing a uniform steel that will not deteriorate by the continued application of great heat, and, unlike carbon steel, can be worked in large masses with perfect reliability, a quality of vital importance in the general uses of steel. We illustrate a 5-ply combination plate, consisting of alternate layers of welded chrome steel and iron, used quite extensively for building purposes throughout the country in the construction of bank and safe-deposit vaults, prisons, jails, and other buildings of security.

An important feature of chrome steel over common steel is that it CANNOT BE CUT OR BROKEN by the finest steel saws, drills or chisels, as it is much harder than such tools can be made. It is, therefore, particularly adapted for window-guards, gratings, doors and other constructions previously referred to. Its cost above the common iron used for such purposes is trifling compared with the increased security assured.

The Chrome Steel Works of Brooklyn, N. Y., who are the sole manufacturers of "chrome steel," furnish this material in the following shapes: ROUND BARS for corridors, window and door gratings; FLAT BARS for lattice and diamond gratings; 5-PLY PLATES for cell construction, floors and ceilings; 5-PLY ANGLES also for cell construction. They also manufacture a chrome tool-steel in rounds, squares, octagons and irregular shapes, which

will do from three to four times more work in all the various kinds of tools than carbon steel



5-Ply Combination Plate. Welded Chrome Steel and Iron.

will. If further evidence is wanted as to the superior properties of this material, send for sample, and saw it, drill it, cut it—if you can.

CHROME STEEL WORKS,
BROOKLYN, N. Y.

A FEW POINTS ON ROOFING PLATES.

PHILADELPHIA, PA, September 21, 1887.

EDITOR STOVES AND HARDWARE:

WITH reference to the discussions appearing in your *Journal* and others from time to time, in regard to roofing and other materials used for building purposes, will you allow us to present a few points that we know cannot fail to be of interest to your many readers. Considering, for instance, the number of firms that are now advertising their respective brands of roofing plates, each claiming superiority for their own goods, can any one wonder at the difficulty experienced by those wanting to use the best, in their endeavors to select same?

We have not the statistics at hand to show the enormous amount of roofing plates, annually imported into America, but we venture to say that an investigation would prove that at least two-thirds of the whole amount are of poor quality. *If a roofing plate, made of the proper materials, be well laid, it will last forty years, with no expense for repairs other than that for painting every three or four years.* The advertisements of two, three or more firms frequently appear in one and the same journal, and as each firm represent their own goods as the best, it simply becomes the duty of the purchaser to test and compare the different brands, making his selection entirely upon the merit of same.

Many readers are evidently not aware that in the manufacture of all roofing plates, a large proportion of imperfect sheets arises; these being sheets with spots left uncoated with tin, having holes, ragged edges, etc. These waster plates are packed in the same kind of boxes as the primes, the only difference being that the letter "W" is branded on the box in order to indicate the different character of the goods. Wasters are largely sought after by roofers, and, we regret to say, are too often used to the detriment of the best goods. Now the important question suggests itself: What does the seller (offering good goods to the trade) propose to do with these imperfect or waster sheets? To those desiring to avoid having inferior roofs, this question carries important considerations.

In introducing the "Gilbertson's Old Method" to the trade, this firm have published far and wide, a letter from the manufacturers over their own signature, to the effect that no wasters of the "Gilbertson's Old Method" would be shipped to the United States; and this has now been in force for nearly two years. This is our reason for claiming that a roofer in buying the brand named, can get but one kind, and that the best. As no other importer or seller of dipped plates has yet put forward any statement similar to the above, either upon their own responsibility or by authority of the maker, our brand is certainly entitled to the confidence of the trade for the successful adoption of this feature, even if it were the only point of superiority over others that we had to offer; without any reference to the heavier coating, *finer assortment of the sheets, etc.* Until other sellers make such an announcement, what security are they giving to property-owners to whom they apply to have their goods used, that the said property-owners will get the best?

We believe in competition, but we refuse to compete with houses that we know are importing the wasters of their brands, and who, in selling the same to any roofer at a price much below that asked for prime plates, very often defeat the object that the architect and others wanting only first-class goods have in view. As we were the first house in America to give a positive and definite guarantee with roofing plate, and the first to stamp every sheet with the brand and thickness (because of the many cases coming to our notice where our brands were specified and something inferior substituted) we feel that we cannot do the public a better service at this time than to call their attention to the fact that, so far as we know, the "Gilbertson's Old Method" is the only brand of dipped plates in the market to-day of which the waster sheets are not imported. To this statement we challenge contradiction, and in justice to ourselves and the roofers who use our plates, we say that *until others can offer but one kind, and that the best*, we do not believe in remaining silent in regard to so important a matter, as it is a subject which concerns not property-owners alone, but all who desire a first-class tin roof.

Yours truly,

MERCHANT & CO.

SPOTS UPON PLASTER CEILINGS.

NEW YORK, Nov. 14, 1887.

TO THE EDS. OF THE AMERICAN ARCHITECT:—

Dear Sirs,—In your last issue Mr. Charles Tennant Lee gives the result of his investigation regarding the brown spots appearing upon plaster ceilings, and suggestions as to obviating their occurrence; provided that the plasterer or mechanic is careful in the selection of his materials, and is not hurried in the work the suggestions might be executed and frescoed and painted ceilings would not be defaced by discolorations and stains. It is, however, to be feared that in the rush to complete a building, proper care may be lacking. The only material I have found that can be applied to ceilings, and that soon after plastering, and which will effectually prevent stains appearing, is English Duresco. I have had it under observation for many years, and it has never failed in this respect. It is a liquid which stops suction, and closes the pores of plaster and similar material. It is also made as a body color, so that the prevention of stains appearing and decoration or fresco work can be performed in one operation.

Yours truly, HOWARD FLEMING.

DISSOLUTION OF PARTNERSHIP.

NEW YORK, October 1, 1887.

THE firm of A. L. Fauchére & Co., Importers and Workers of Foreign and Domestic Marbles, has been dissolved by mutual consent, Mr. Fauchére withdrawing from the firm. The business in future will be conducted by the new firm of Batterson, See & Eisele, successors to A. L. Fauchére & Co., at their new works, 425, 427, 429 and 431 Eleventh Avenue, New York.

Colored marbles, building and monumental work, are specialties which receive our best attention.

The Mutual Life Insurance Co.'s new building on Nassau Street, the new Equitable Building on Broadway, are evidences of our ability to turn out large contracts with a despatch hitherto unexampled in the trade.

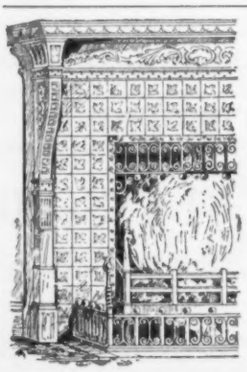
Mexican, Algerian and Californian onyx, with other choice materials in use, supplied on short notice. Yours respectfully,

JAMES G. BATTERSON,
WALTER F. SEE,
JOHN EISELE.

All orders and correspondence should be addressed to

BATTERSON, SEE & EISELE,
431 ELEVENTH AVENUE, NEW YORK.

STAIR'S BOSTON HARD WAX - POLISH
FOR FLOORS.
E. D. STAIR, Original Manufacturer.
7 W. 14th Street, NEW YORK.



PHILADELPHIA GRATE WORKS.
HENRY P. DIXON & CO.,
MANUFACTURERS OF
Grates, Open Fireplaces, Furnaces, Ranges, Gas Logs.
DEALERS IN
Wood-Mantels, Tile-Hearths & Facings.
1330 Chestnut St., Philadelphia, Pa.

A. G. NEWMAN, late NEWMAN & CAPRON.
MANUFACTURERS OF
Fine Bronze Hardware, Bank, Office and Stoop Railings in Bronze or Brass. Antique Furniture-Trimmings. Electrical and Mechanical Bell-Hanging Burglar-Alarms.
Warerooms, 1180 BROADWAY. Factory, 157-163 WEST 29th STREET, NEW YORK, N. Y.

NOTES.

On Wednesday and Thursday of this week, Messrs. J. S. Conover & Co. offered to lovers of beautiful things at their establishment on West Twenty-third Street, New York, their annual exhibition — it is something more than an "opening" such as milliners announce at the turn of the season. Their warerooms are well adapted to such an exhibition, and, pains have been taken to make the several compartments into which the space available has been divided thoroughly consistent and harmonious in their artistic treatment; the individuality of each exhibit is preserved so far as possible by separating *portières*, which add to the general effect of richness, as do the rugs and *bric-à-brac* that are introduced for the sake of making each exhibit look more homelike, less like a shop-window dressed up to catch the holiday trade.

Each compartment has for its central attraction a fireplace and its usual surroundings in a well-defined style, the material chiefly used being different in each case. Thus, in one room the visitor can study the effect that can be obtained in white and gold; in the next, the richness of wrought, turned and chased brasswork is displayed; in another, the elegant refinement and finish due to real bronze is shown, while in another, the manner in which the grimy Grand Duke of metals, iron, can be wrought to delicate effects is admirably shown.

But besides the fireplace fittings, grates, andirons, fireirons, etc., which form the nucleus of their trade, Messrs. Conover & Co. make and deal in other artistic wares, mainly wrought in metal, such as lamps, standard, hanging, bracket, reading, and candelabra of all kinds and sizes, music-racks, tables, little and big, with onyx, marble or inlaid tops, and other fittings for luxurious homes, which are here shown arranged attractively and in good taste.

Although this exhibition is dated for two days only, it will probably be visible for a much longer time, and will interest any one who can find time to visit it.

The Gurney Hot-Water Heater Company of Boston have lately issued two colored posters which show, one of them, a sectional house-interior, which gives ocular demonstration of the way in which this system of heating can be applied to all the varied needs of house-keeping, and the other — the most useful from our standpoint — showing on a large scale the working parts of the heater itself.

PROPOSALS.

CAST-IRON PIPE.

[At St. Louis, Mo.]

Depot Quartermaster's Office,
St. Louis, November 8, 1887.

Sealed proposals will be received at this office **until 12 o'clock, noon, on Thursday, December 8, 1887,** at which time and place they will be opened in the presence of attending bidders, for furnishing and laying complete a cast-iron six-inch water-pipe, from the southern boundary of the city of St. Louis, Mo., to Jefferson Barracks, Mo.

Blank proposals, specifications and such further information as may be desired, may be had upon application at this office.

The Government reserves the right to reject any or all proposals.

Envelopes containing proposals should be distinctly marked "Proposals for laying iron water-pipe from St. Louis, Mo., to Jefferson Barracks, Mo.," and addressed to the Depot Quartermaster, St. Louis, Mo.

C. W. FOSTER, Quartermaster,
623 U. S. A. Depot Quartermaster.

DAM.

[At South East, N. Y.]

Aqueduct Commissioners' Office,
Room 209, Stewart Building, 280 Broadway,
New York, N. Y., Nov. 17, 1887.

Bids or proposals for doing the work and furnishing the materials called for in the approved form of contract now on file in the office of the Aqueduct Commissioners for building a masonry dam and work connected therewith on the East Branch of the Croton River in the town of South East, Putnam County, New York, will be received at this office **until Wednesday, the 7th day of December, 1887, at 3 o'clock** P. M., at which place and hour they will be publicly opened by the Aqueduct Commissioners, and

English Editions.

THE LEONARD SCOTT PUBLICATION COMPANY since January 1st, 1887, has furnished its Subscribers with original sheets of the

Fortnightly Review, and the Contemporary Review. The Nineteenth Century will be issued to correspond.

No American, desirous of keeping abreast of the times, can afford to be without these three great English Monthly Reviews. Their contributors comprise the foremost and ablest writers of the World, and their contents treat of the latest and most important phases of modern thought.

Terms: $4.50 each; any two, $8.50; all three, $12.00.

Edinburgh Review. Quarterly Review. Scottish Review.

We take great pleasure in announcing that we shall continue the issue in America of these two English Quarterlies.

Under an arrangement with the English publisher, this Company assumes exclusive control of the American issue.

Blackwood's Magazine.

Is the leading and most popular monthly of Great Britain. The tone of its articles is unexceptionable, rendering it most desirable for the Home Circle.

Terms: $3.00 each; any two, $5.50; any three, $8.00; all four, $10.50.

Westminster Review. FIRST MONTHLY ISSUE, APRIL, 1887.

This Review will continue faithful to its mission as an organ of independent thought in respect to social, political, philosophical and religious questions.

Terms: $4.00 per Year; 35 cents per Number.

Shakespeariana. —AN AMERICAN MONTHLY.— Aims to tell the news, and mirror the progress of the Shakespearian world; to encourage the influence of Shakespeare reading, and to offer suggestive courses of study; to be of use in Colleges and Schools, Libraries and Reading Rooms, and to prove of interest not only to Shakespeare specialists, teachers, and reading-circles, but to the actor, the dramatist, and the student of general literature.

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QUARTERLY INDEX OF LEONARD SCOTT PUBLICATION CO.'S PERIODICALS.
No. 1. JANUARY, 1887—INDEX FOR 1886.
SUBSEQUENT ISSUES FOR EACH QUARTER.

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"BUILDING SUPERINTENDENCE."

THE BEST AND LATEST TREATISE IN
AMERICAN PRACTICE IN BUILDING,
Clear, Reliable, and Complete.
Price, $3.00.

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TO ARCHITECTS AND CONTRACTORS:

We desire to call your attention to the Superior quality of **Plate Glass manufactured by the**

PITTSBURGH PLATE GLASS CO.

The Largest Plates of Glass in buildings in the cities of Chicago, Cleveland, Detroit, St. Paul, Syracuse, Pittsburgh, Philadelphia, Baltimore, and many New York buildings, were manufactured by our Company.

The only fuel used throughout both our works is **Natural Gas**; which, owing to its superior heating power and cleanliness, enables us to produce an article which **cannot be surpassed,** besides glass melted and annealed by our process with this gas is far more durable and not so liable to break.

We make a specialty of three-sixteenths thickness for fine residences, also extra large sizes, wide and long plates for store fronts, beveled and obscured plates, skylight and floor glass.

With a capacity of 200,000 square feet monthly, we are prepared to execute all orders promptly, and invite correspondence.

WORKS No. 1, CREIGHTON, PA.
WORKS No. 2, TARENTUM, PA.

Western Union Wire and Telephone connection in General Office at Creighton, Pa.

E. L. FORD, Sec.

PROPOSALS.

the award of the contract for doing said work and furnishing said materials will be made by said Commissioners as soon thereafter as practicable.

Blank forms of said approved contract, and the specifications thereof, and bids or proposals, and proper envelopes for their enclosure, and form of bonds; and also the plans for said work and all other information may be obtained at the above office of the Aqueduct Commissioners on application to the Secretary.

By order of the Aqueduct Commissioners.

JAMES C. SPENCER, President.
623 JOHN C. SHEEHAN, Secretary.

HYDRANT CASTINGS, ETC.
[At Montreal, P. Q.]

WATER-WORKS OFFICE, CITY HALL,
MONTREAL, November 7, 1887.

Sealed tenders addressed to the undersigned and endorsed "Tenders for Special Castings," will be received at the office of the City Clerk, City Hall, **up to noon of Tuesday, the 13th December next**, for 132 tons of special castings, to be delivered in quantities and at dates as specified below, viz.:

January 15, 1888. 25 Hydrant Castings complete; 10 12-inch Valve Castings.

February 15, 1888. 25 Hydrant Castings complete; 15 12-inch Valve Castings.

March 15, 1888. 25 Hydrant Castings complete; 10 10-inch Valve Castings; 6 8-inch Valve Castings; 12 6-inch Valve Castings; 12 4-inch Valve Castings.

April 15, 1888. 25 Hydrant Castings complete; 10 10-inch Valve Castings; 6 8-inch Valve Castings; 12 6-inch Valve Castings; 12 4-inch Valve Castings.

May 15, 1888. 6 4-inch Valve Castings; 10 tons Tees and Crosses, as may be ordered; 10 tons smaller castings, as may be ordered.

June 15, 1888. 20 tons Tees and Crosses as may be ordered and the balance in smaller castings.

July 15, 1888. The balance of the Tees and Crosses.

Where the ton is mentioned, the ton of 2240 lbs. is meant.

The whole to be in accordance with specification and form of tender to be had at the office of the undersigned.

Any tender not made on the official form, and not in conformity with the terms of this advertisement, will not be considered.

The Water Committee do not bind themselves to accept the lowest or any tender.

LOUIS LESAGE,
624 Supt. M. W. W.

WATER-PIPE.
[At Montreal, P. Q.]

WATER-WORKS DEPARTMENT, CITY HALL,
MONTREAL, November 7, 1887.

Sealed tenders addressed to the undersigned and endorsed "Tender for Pipes," will be received at the office of the City Clerk, City Hall, **up to noon of Tuesday, the 13th December next**, for 1,800 tons of cast-iron water-pipes, to be delivered, free of duty or charge of any kind, at any railway station within the city or on any wharf in the harbor, in quantities and at dates as specified below, viz.:

May	15, 1888,	200	tons of	12-inch	pipe.
June	15, 1888,	200	"	12 "	"
		100	"	6 "	"
July	15, 1888,	200	"	12 "	"
		80	"	10 "	"
Aug.	15, 1888,	120	"	20 "	"
		200	"	12 "	"
Sept.	15, 1888,	100	"	30 "	"
		200	"	12 "	"
Oct.	15, 1888,	100	"	30 "	"
		200	"	12 "	"
Nov.	15, 1888,	100	"	12 "	"

The ton above mentioned is the ton of 2240 lbs.

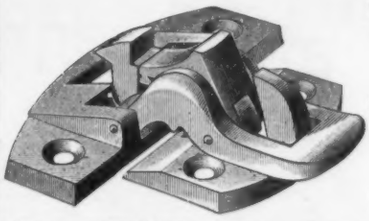
The whole to be in accordance with specification and form of tender to be had at the office of the undersigned, and any tender not made on the official form, and not in conformity with the terms of this advertisement, will not be considered.

The Water Committee do not bind themselves to accept the lowest or any tender.

By order. LOUIS LESAGE,
624 Supt. M. W. W.

DAVIS' AUTOMATIC SASH-FAST.

Patented November 24, 1885.



Window always Locked when Shut.

It will lock itself, when an ordinary fast would not work at all.

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ATLANTIC WHITE-LEAD & LINSEED-OIL CO.,

MANUFACTURERS OF

"ATLANTIC" PURE WHITE LEAD,

—AND—

Pure Linseed-Oil,

Raw Refined and Boiled.

The best and most reliable **White-Lead made,**

And unequaled for

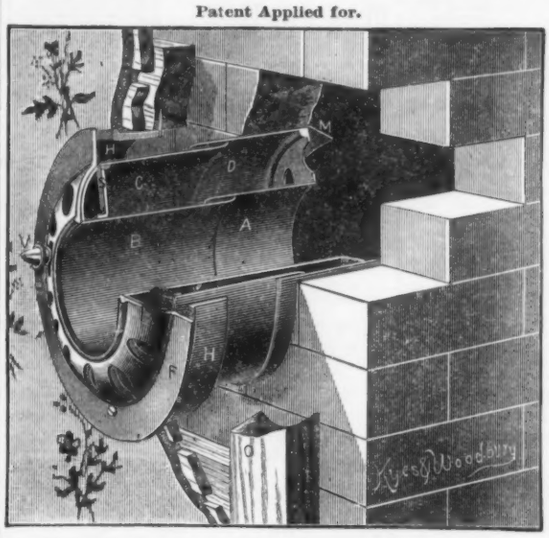
Uniform Whiteness, Fineness, and Body.

ADDRESS,

Atlantic W. Lead & Lin. Oil Co.
287 Pearl St., NEW YORK.

HILL'S SAFETY STOVE-PIPE THIMBLE.

Patent Applied for.



ABSOLUTELY safe against fire.
Adjustable to any thickness of brick and wood work.
Entirely independent of the walls of the room.
Latest and best in the Market.
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HILL DRYER COMPANY,
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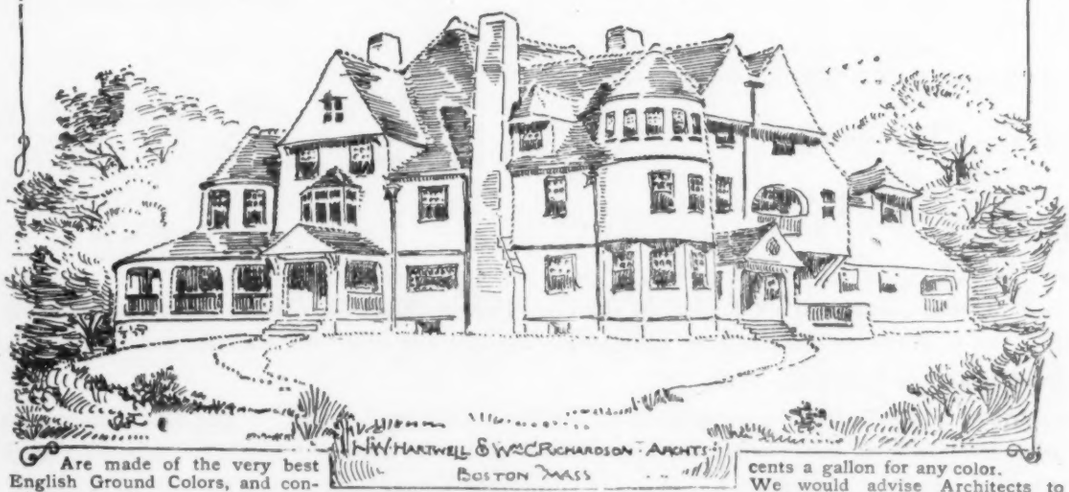
DEXTER BROTHERS' ENGLISH SHINGLE STAINS



Are made of the very best English Ground Colors, and contain no benzine, water, or creosote. They have been thoroughly tested by some of the best Architects in the country during the past three or four years, and the colors are more lasting than any other stain. The price is 75 cents a gallon for any color.

We would advise Architects to specify Dexter Brothers' English Shingle Stain, and note the number on the Sample Boards. Send for Sample Boards of Colors. DEXTER BROTHERS, 55 and 57 Broad Street, Boston, Mass.

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Steam Heating Co.,
208 THIRD STREET S.,
Minneapolis, - Minn.

PUBLIC BUILDINGS,
BUSINESS BLOCKS,
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Perfectly and Economically Heated.

Agents wanted in Indiana, Illinois, Missouri, Nebraska, Kansas, Iowa, Michigan, Wisconsin, Dakota.

Something New for the Stable.
Read's Patent Harness Bracket.

An Article long wanted but never before made.
Holds the whole harness, takes no more room than the ordinary hook or peg, can be used for both single and double harness. Gives the harness-case a neat appearance, as it carries the harness up uniformly in width with the saddle, beside keeping the bridle and breastplate in their proper shape. They are neatly japanned, with gilt facings. Price $18 per dozen. Are now in use in over 100 first-class private stables in and about Boston.
Each bracket lettered "J. J. Read, Boston, Mass." For sale by dealers everywhere.
Indorsed and approved by the following named gentlemen, all of whom have them in use:
Boston: R. H. White, J. Montgomery Sears, J. T. Morse, Jr., Thos. Motley. South Boston: Benjamin Dean. Cambridge: F. A. Kennedy, John Bartlett, Chas. H. Gass. Portsmouth, N. H.: Hon. Frank Jones. Milton: Col. H. S. Russell, J. Malcolm Forbes. Dedham: A. W. Nickerson. Baltimore, Md: J. D. Mallory. Newton: J. C. Potter, C. E. Billings, A. R. Mitchell. Waltham: J. H. Ellison. Readville: C. G. White. Beverly: Dr. Chas. Haddock. Swampscott; C. P. Curtis. Boston, Mass.: Waldo Adams, with the Adams Express Co. Philadelphia, Pa.: Edward N. Williams, of the Baldwin Locomotive Works.
The public are cautioned against all similar brackets, not marked with my stamp, as such brackets are infringements of patents held by me.
Also cedar-top riding-saddle bracket. Price $3.50 each. And whip-rack for English coach and straight whip combined. Price 50 cents each.
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Drawings rendered in line or color with reasonable despatch.

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211 Tremont St., Boston, Mass.

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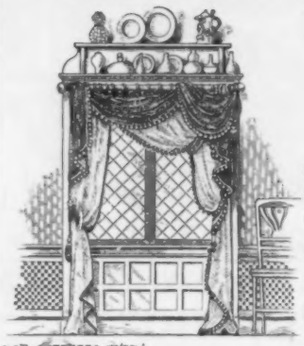

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Special attention given to the furnishing of Private Residences, Hotels, etc.
Estimates given if desired, and competent men sent to examine and execute the work.

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Every Excellence of Mechanism. Latest and most approved Styles and Finish
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Our Hardware may be found in important buildings in the leading cities of the Country.

OFFICE OF THE
"SANITAS" MANUFACTURING CO.,
Manufacturers of
"SANITAS" PLUMBING APPLIANCES,

Boston, October 20, 1887.

Mr. I. Henry Paige, Agent *"American Architect":*

Dear Sir,— Since inserting our large "ad." in your paper we have heard from it in so many ways, from all parts of the Country, that we think it only just you should know of it. It has been a far better paying advertisement than any of the many we have ever made within the last five years, and its value has much exceeded our expectations, great as they were.

We attribute a very surprising increase in our business, since its insertion, largely to the manner in which your paper has placed our goods before the very ones we were most anxious to reach, and it is our present intention to continue the "ad." indefinitely. Sincerely Yours,

SANITAS MF'G. CO.

This Caps the "Climax."

THE "CLIMAX" RAIL FOR SLIDING DOORS.

OFFICE OF
GEO. F. TAYLOR, Business Manager,
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"CLIMAX" RAIL CO.,
PATENTEES AND MANUFACTURERS

New York, Oct. 20th 1887.

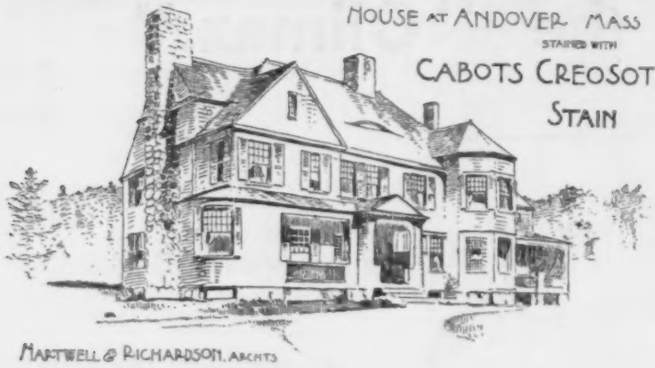
Mr. H. M. Carleton
N. Y. Agt. "Am. Archt. & Bldg News"
Dr. Sir

Some months ago we stopped our advertisement in Your paper, in order to Enable us to "Catch up" with our orders. Our business almost immediately dropped off nearly forty per Cent. It is now a little over a month since we sent You word to again insert it, and already we are inundated with orders, as the result. Your readers are just the ones we desire to reach; intelligent, progressive men who are quick to know a good thing when they see it, specify it in their plans and insist upon having it, for this reason the Am. Architect pays us better than all other advertisements and Methods of advertising Combined.

Yours very Truly

Climax Rail Co.
134 water st
N. Y.

CABOT'S CREOSOTE STAIN

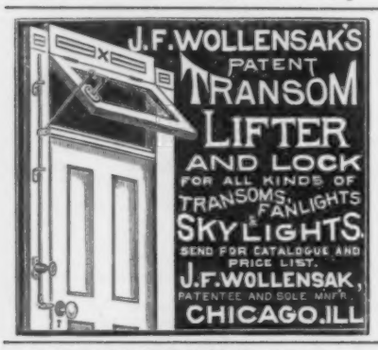


Is the only true exterior Stain made, all others are merely thin paints. Our stains have been in use since 1881, and have given excellent satisfaction, both as to durability and for the artistic effect they produce.

Price, 30c., 50c. and 75c. per gall. according to color.

Send for Circulars and Samples.

SAMUEL CABOT, - - - - 70 Kilby St., Boston.



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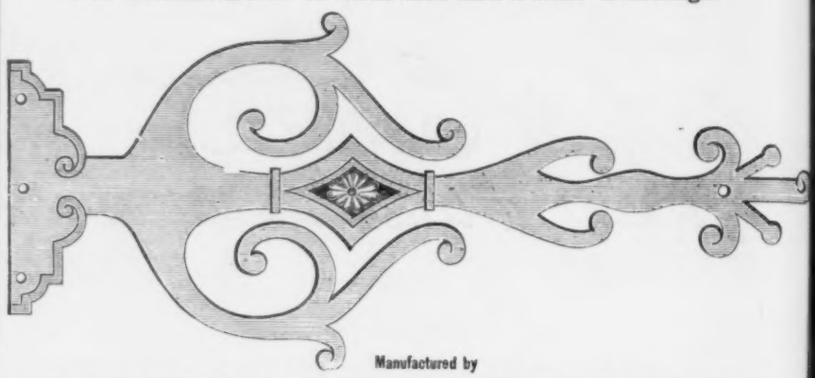
For Outside Doors of Churches and Public Buildings.



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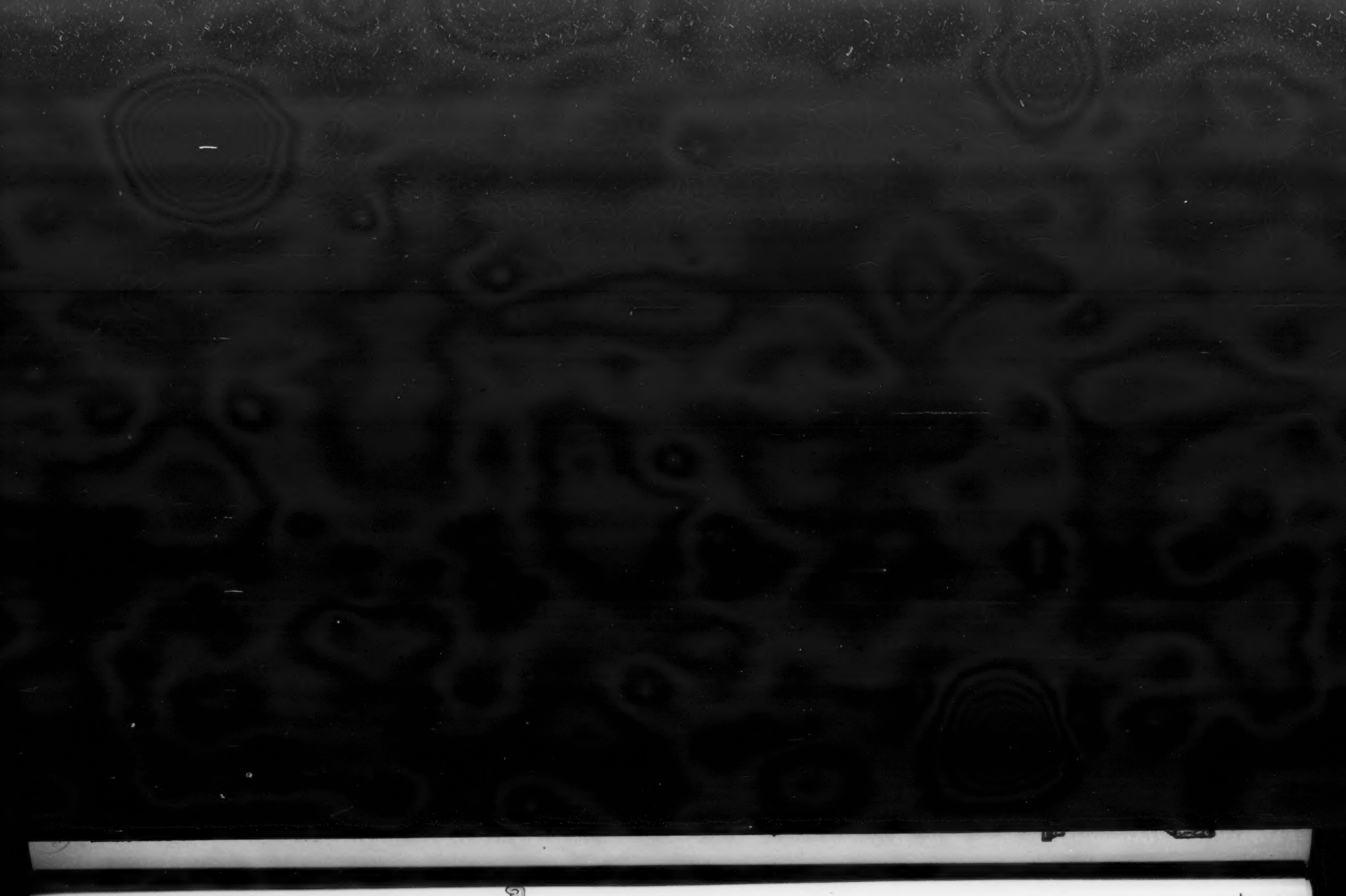
To Architects and Builders.

Adopt MAHOGANY for interior finish; it is the handsomest and most durable cabinet wood known, and we are prepared to furnish it at prices that compare very favorably with those ruling for other hard-woods.

Correspondence solicited.

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